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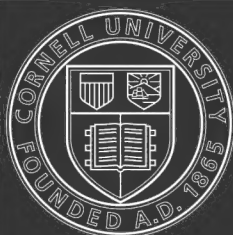
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MEMOIRS OF THE GEOLOGICAL SURVEY,
UNITED KINGDOM.

ECONOMIC GEOLOGY

OF THE

ISLE OF MAN,

WITH SPECIAL REFERENCE TO THE

METALLIFEROUS MINES.

BY

G. W. LAMPLUGH, F.G.S.

[REPRINTED FROM THE MEMOIR ON THE GEOLOGY OF THE ISLE OF MAN, 1903.]

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P R E F A C E.

The following account of the Economic Geology of the Isle of Man deals principally with the metalliferous mines, and is a reprint of Part III. of the Memoir on the Geology of the Island. It is issued as a separate volume to meet the requirements of those who are especially interested in the mines.

The original paging is retained, together with the cross-references to other portions of the complete memoir. As stated in the preface to the larger work, our thanks are due to the managers of the mines throughout the island, without whose cordial co-operation it would have been impossible to collect the information contained in the following pages.

The Commissioners of the Woods and Forests also aided us by giving Mr. Lamplugh access to the documents in their possession, amongst which are the valuable manuscript reports of the late Sir W. W. Smyth. The particulars as to old workings have been principally obtained from these documents, and it is believed that these particulars will be of considerable local interest and value.

J. J. H. TEALL,
Director.

*Geological Survey Office,
28, Jermyn Street, London,
13th March 1903.*

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ECONOMIC GEOLOGY

OF THE

ISLE OF MAN.

CHAPTER XII.

THE METALLIFEROUS VEINS OF THE ISLAND.

HISTORICAL AND INTRODUCTORY.

In proportion to its area the metalliferous wealth of the Isle of Man has been great. Two of its mines have stood, for a long series of years, in the first rank in the British Islands for productiveness, respectively, of silver-lead and of zinc. These metals have constituted its principal riches, but copper-pyrites and hematite-iron have also been raised in marketable quantity. Of ores of nickel and antimony only minute quantities have been found, while of gold the reported occurrences are not well established (p. 549).

As veins yielding traces of the useful metals are frequently exposed in the cliff-sections, it is not surprising to find that they attracted attention at an early date, and are mentioned in the ancient records of the Island.

The great lode of Bradda Head (see p. 530), with its gangue of white vein-quartz cutting vertically through the cliffs of dark slate, stands up so conspicuously when viewed either from land or sea that it must have received notice as soon as this part of the Island became known to men acquainted with the use and mode of occurrence of its metals.

Hence, so far back as history goes we hear of this lode; and the miners of later days have found workings of unknown date in which the ore had been extracted by the use of 'feather-wedges,' a method abandoned upon the introduction of gunpowder.¹ These old workings have been vaguely assigned to "the Romans"; but though the Island was known to that nation the absence of Roman antiquities renders it improbable that any attempt was made by these invaders to colonise it.

¹ Cumming, "Isle of Man," p. 306; also Berger Trans. Geol. Soc., vol. ii., p. 51.

We are informed by Mr. A. W. Moore, the historian of the Island, that in the course of his researches¹ he finds the first mention of the Manx Mines in 1246. The island was at that time still under the dominance of Norway; and its King, Harald II, granted a charter by which the monks of Furness Abbey obtained the right to work the mines.² The previous existence of the mines is thus distinctly implied.

Cumming notes that "it is stated in Chaloner's 'Ca'ledonia' (vol. iii., p. 372) that John Comyn, Earl of Buchan, obtained from Edward I. a license to dig for lead in the Calf of Man to cover eight towers of his Castle of Cruggleton in Galloway. In the course of the 15th, 16th, and 17th centuries, the noble family of Stanley appear to have sought for copper in the same neighbourhood; traces of their labours remain. The ore discovered, though not abundant, was rich in quality, producing six pennyweights of copper per ounce of ore."³

From Mr. Moore's researches we learn that in 1406 "mines of lead and iron" were included in the grant of the Island to Sir John Stanley by Henry IV.; and in 1422 it was ordered that the lord's mine should be managed by his "Lieutenant, Receiver, and Comptroller,"⁴ who had to see that the miners did their duty. In the middle of the 17th century, Chaloner mentions that Capt. E. Christian found the Ore of Lead at "Mine-hough" [Mine-howe?] or Bradda Head to contain much silver.⁵ After the Restoration, mining was prosecuted more systematically; and from that time both lead and copper seem to have been diligently sought, the lord letting his rights in the mines on condition of receiving one-fifth of the produce. In 1668 a lease of all the mines in the Island, with leave "to erect a smelting mill, or more than one, for the smelting of the oar-mynes and minerals," was granted to two merchants, one of London, and one of Liverpool.⁶

In the following year Charles, the 8th Earl of Derby, at that time Lord of Man, "being by good reasons persuaded y^t there is plenty of coales" in the Island, ordered the Governor to institute a search for it.⁷ In 1699 the lord's fifth of the lead and copper ore amounted to 32 tons 13 cwt. About this time also the hematite iron-ore of Maughold received attention, Mr. Moore finding it on record that in the year 1700 there was shipped from the mine at "Daunane" (Drynane, see p. 126) 227½ tons of this ore.⁸

¹ Since this chapter was written, Mr. Moore has included an account of the progress of Manx mining in his "History of the Isle of Man" (2 vols. 8v., London, 1900). Vol. ii., pp. 960-971.

² "Cott. MSS., Manx Soc., vol. vii., pp. 79-81."

³ "Isle of Man," p. 307.

⁴ "Statutes," vol. i., p. 19.

⁵ See reprint by Manx Soc., vol. x., p. 8.

⁶ "Loose sheets in Seneschal's Office" [A. W. Moore].

⁷ *Ibid.*

⁸ *Ibid.*

Governor Sacheverell, in his "Account" of the Island published in 1702, writes:—"I am informed, since I left the Island, they have discovered very good mines of Lead, Copper, and Iron, and great probability of Coal."¹

The strenuous efforts made about this time to encourage mining are illustrated by the following notice, published in 1714 (for copy of which we are indebted to Mr. Moore):

'Forasmuch as our hon^{ble} Lord hath been pleased for the discovery and finding out mines within this Island . . . to send over an order . . . that any person who shall find out any veins of Lead or Copper . . . such as shall be thought fitt for working by the Steward or overseer of the said workes . . . shall not only have paid down to them fourty shillings as a reward, but shall have the preference of working the said mines . . . and three pounds a ton for every ton they shall get, delivering unto the Steward a fifth part of what oare they shall raise after the same is cleansed and made merchantable, provided they begin and prosecute the said work within three months.'²

A few years later, Bishop Wilson wrote as follows:—"Mines of coal there are none, though several attempts have been made to find them; but of lead, copper, and iron there are several, and some of them have been wrought to good advantage, particularly the lead; of which ore many hundred tons have of late been smelted and exported. As for the copper and iron ores, they are certainly better than at present they are thought to be, having been often tried and approved of by men skilled in these matters: however either through the ignorance of the undertakers, or by the unfaithfulness of the workmen, or some other cause, no great matter has as yet been made of them."³

From this statement it appears that the metals were raised in the same relative proportions at that time as at present, excepting that the zinc-blende associated with the lead-ores, formerly of little or no value, is now a product of considerable worth. The repeated attempts since made to work the veins of copper and iron have met with no lasting commercial success, and it seems to have been demonstrated that those ores do not occur in sufficient quantity for profitably winning under current conditions of price.

In the above accounts the only localities actually mentioned are Bradda Head, The Calf, and Maughold, all places where the metalliferous veins are visible in the cliffs, though it is probable that trials had also begun on the richer deposits of the interior. Dr. Berger in his description of the mines in 1814 has the following note:—"Mr. Fitz-Simmons, who is preparing to publish an extensive work on the ancient History of the Isle of

¹ Manx Soc. Reprint, p. 17.

² "Lib. Scacc." [A. W. Moore].

³ Bp. Wilson's "History, etc.," in Camden's "Britannia," 1772, p. 392, Manx Soc. Reprints, vol. xviii., pp. 94-5.

Man, states that mention is made of the mines of the Isle in the time of Sir Stanley 1st and 2nd." (*Foot note*—"The first Sir Stanley appointed King of Man, was by grant from King Henry 4th in the year 1407.") "Those at Brada, he believes, were first wrought; whether those at Foxdale were then opened may be doubted; those at Laxey were opened and wrought by a mining company of Cumberland, about the commencement of the last century

"Mr. W. Geneste informs me further that he lately found in some books (titled Charge of the Revenue) in the Duke's office in Douglass (called the Seneschal's office) that the last Earl of Derby had the mines wrought, paying the workmen at the rate of £3 Manx per ton for the ore (lead) raised. In 1709, he paid the miners for about 70 tons; from 1709 to 1713, about 30 tons yearly. A new smelting house was built in 1711. The workings of the mines was totally suspended about 3 years ago."¹

Among the papers preserved in the Office of Woods and Forests in London relating to the mines of the Island are several relating to a grant, made in 1679 by King Charles II. to Charles, Earl of Derby, of a Lease of "all Mines Royal of gold or silver, or holding gold and silver to such a proportion as according to the Laws of the Realm of England doth make the same a Mine Royal." This lease had expired by the failure of the Heirs male of the grantee on the death of James, Earl of Derby in 1735, but was revived on the petition of John, Duke of Athol in 1780, upon a declaration made by P. J. Heywood, a former Deemster of the Island:—"That he is enabled to declare of his own knowledge and from what he hath heard, that there are not any mines of Gold or Silver in the said Island; that the only mines which now are or ever were wrought in the said Isle, as he hath heard and believes, are Mines of Lead and Copper. Except that he hath heard some Mines of Iron have been worked formerly, and that he hath been informed by persons experienced in the knowledge of mines that there is a proportion of silver in the Lead-mines now working, but so small as by no means to answer the expence of assaying and separating."²

Feltham, in 1798, describes the mining work then in progress at Laxey and Foxdale, but found the Bradda mines closed.³

Woods, in his account of the Island published in 1811,⁴ gives some interesting data respecting the mines then existing. These were at Laxey, Foxdale, and 'Breda' Head; and he mentions also deserted shafts of lead-mines with rubbish-heaps between Port Erin and Kirk Arbory, no doubt referring to those since reworked as the Ballacorkish or Rushen mines (see p. 532). He speaks of Bradda as a copper mine, but did not visit it. Foxdale he found deserted and drowned (see p. 500). Laxey was being worked by two levels from the banks of the river and yielded

¹ Trans. Geol. Soc., vol. ii., p. 51.

² In a Report of the Surveyor-General to the Royal Commission.

³ "Tour through the Isle of Man," pp. 213, 243.

⁴ "Account of the Isle of Man," pp. 10-20.

silver-lead, blende and copper (see p. 519). He mentions that a small quantity of compact brown ironstone occurred immediately under the breccia (Carboniferous Basement Beds) in the Silverburn near the mill below Athol Bridge. The old level at that place to which reference was made on p. 197 was perhaps in connection with this ore.

Quayle also published details respecting some of the workings in 1812.¹

Macculloch, in his work published in 1819, discusses the metalliferous veins of the Island at some length.² He notes that the mines were all abandoned, with no prospect of renewal—a statement which in view of the later highly successful results obtained from Foxdale and Laxey may afford some prospective encouragement to the hopeful adventurer on old workings in the Island. He speaks of Laxey, Bradda Head and Foxdale as the three principal veins, but found that work had been carried on also at Ballacorkish and Glensash (Glenschass, see p. 536) near Port St. Mary; and some other small north and south veins near Port Erin were pointed out to him by old miners, (probably at Bay Fine and Calf Sound, see p. 532).

The following are the "Mines and Minerals" catalogued in the "Schedule of the Property" conveyed by the Duke of Athol to the Crown in 1827-8 (MS. in Office of Woods and Forests):—

LEAD MINES.	YELLOW OCHRE
New Foxdale.	Mallew.
Old Foxdale.	
Flappy Vein.	LIME STONE.
Balla Corkish Vein.	Port le Mary.
Silver Bourne Vein.	
Glen Chass Vein.	BLACK LIMESTONE.
Bradda Head Vein.	Pool Vasle [vash].
Laxey Vein.	
COPPER MINE.	SLATE.
Bradda Head.	South Barrule.
IRON STONE.	STONE QUARRIES.
Maughold Head.	Gob e Valley.
POLISHING POWDER.	Spanish Head.
Ballastole.	COAL.

Among other papers relating to this transfer preserved in the Woods and Forests Office in London are copies of the leases under which the mines were worked, and plans showing the extent of the development of the more important mines up to that time. These plans will be referred to when the mines are separately described.

¹ "General View of the Agriculture of the Isle of Man," pp. 9-10.

² "Western Isles," vol. ii., pp. 574-577.

The third and fourth decades of the 19th century marked a great revival and development of the Manx mining industry. After that time its steady progress may to some extent be traced in the Mining Statistics published in an early memoir of the Geological Survey and in the Records of the School of Mines (see pp. 495-8).

Cumming gave a full account of the condition of the mines as he found them in 1845-1848.¹ He notes that the Foxdale mining ground, extending eastward across the northern side of South Barrule from Glen Rushen, had hitherto proved the most productive on the Island; and thinks that the proximity of the granite had very beneficially affected its mineral riches. The company then working this group of mines generally employed about 350 men and boys, and the average raising of silver-lead ore for the previous ten years had been about 2,400 tons per annum. Laxey also, he states, was being worked by a new company employing 300 men and raising 60 tons of lead, 200 tons of blende mixed with lead, and 5 tons of copper ore per month; the deepest working being 130 fathoms below the adit-level. The other mines which he mentions are the Ellerslie on the Bishop's Barony near Crosby (see p. 516), which was being worked without success; a Copper Mining Company in Maughhold parish, also unsuccessful; and the iron mines in the same parish, in which about 70 men were employed and ore raised to the extent of about 500 tons per month.

During the ensuing twenty or thirty years the great prosperity of the Foxdale and Laxey companies led the investing public to take shares readily in Manx mining enterprises, and stimulated the search for metals in every part of the Island. Numerous new companies were formed, and mines established on the slenderest prospects, with of course almost uniform ill-success. In some cases no ore whatever was obtained; oftener the vein yielded a little lead, zinc, or copper, in quantity too small to be marketed; while in a few instances sufficient ore was found to be worth selling, but less than paid the working expenses. The wrecks of these mines, with their ruined buildings and plant, are strewn here and there over the whole area occupied by the Manx Slates. It is impossible at the present time to obtain in the Island definite information regarding many of these; but fortunately, through the courtesy of the Commissioners for the Woods and Forests, we have been allowed access to the reports made annually between the years 1857 and 1888 by the eminent mining authority, Sir W. W. Smyth, who, in his official capacity as Chief Mineral Inspector for that department, examined most of the workings at the period of their activity, and reported fully. We are also indebted to Mr. W. H. Rowe of Douglas, for placing at our disposal his collection of plans and details of old mines. From these and other sources duly acknowledged in the context, the descriptive accounts of these ventures given in the succeeding pages have been prepared.

¹ "Isle of Man," Appendix K., pp. 306-311.

GEOLOGY OF THE METALLIFEROUS VEINS.

General Characters.

While the lodes which have been mined to commercial advantage in the Isle of Man are only two in number, viz., that of Foxdale and that of Laxey, it has been demonstrated by the numerous other workings that ores of lead, zinc, iron and copper are present in a minor degree in veins in almost every part of the Manx Slate Series. These veins have in all cases the character of infilled fissures which break across the stratification of the rocks. Relative displacement of the walls of these fissures has probably occurred in most cases, but usually only to a slight amount; and it is exceptional to find indications of considerable faulting along them. The principal vein is generally accompanied by rudely parallel veins and branches which are sometimes in themselves metalliferous, the whole forming a more or less complex group. Occasionally they are broken and displaced by later transverse faults, as will subsequently be described. Almost invariably they are inclined, at angles of from 5° to 30° or more degrees from the vertical, this "hade" varying in amount as the vein is followed downward, but usually constant in direction. In rare instances the "hade" is temporarily reversed, a change considered by the miners to be unfavourable to the productiveness of the lode.

The veins are subject to great and sudden variations in breadth and in mineral contents, the metalliferous deposits rarely form more than a small proportion of their infilling, the greater part of the fissure being occupied by crystalline quartz, calcite, dolomite, with sometimes a little barytes, fluor-spar, etc., and by breccia and decomposed material derived from the walls. Gas- or water-filled cavities known as "lochs" or "vughs" are likewise frequent. The valuable ores sometimes occur in definite ribs in the vein-stuff, and sometimes in disseminated crystalline grains, or in both forms combined. It is clear that the crystalline constituents, both metalliferous and non-metalliferous, have been slowly deposited in open cavities. In some cases, mostly in the Foxdale Lode, there are indications of movement of the walls after partial infilling of the fissure, causing portions of the vein-stuff to be displaced and brecciated. The fissures have been found to extend vertically, with or without ore, as deeply as the deepest mining works have gone, viz., not far short of 2,000 feet below the present surface at Foxdale and at Laxey; laterally, the Foxdale lode in one or another of its branches has been traced almost continuously for $2\frac{1}{2}$ miles, and the Laxey Lode for over a mile; but in most cases the veins have been found to split up or otherwise become indistinguishable within much shorter distances.

Direction of the Lodes.

The main lode-system at Foxdale has a nearly east-and-west course, and the smaller veins at the old Cornelly Mine

a mile north of Foxdale, and at the Bishops Barony Mine three miles east of Foxdale, have also this direction; but at Laxey, Snaefell, Ballacorkish, Bradda, and in fact at almost all the other workings from which ore has been obtained, the direction of the lode has been approximately north-and-south, or more strictly, a little (5° — 30°) to the west of north and east of south. In only one or two unimportant instances has any ore been found in N.W. and W.N.W. veins; while apparently not a single case of a productive north-easterly vein is known, although this is the direction of strike of the rock-masses and of innumerable quartz-veins accompanying planes of cleavage, crushing and fracture (see pp. 86–7). It is true that the predilection of the miners for north-and-south veins has led to these being tested in far greater numbers than those in any other direction, and that this selection may in some degree have affected the result; but the extent to which veins of every kind have been cross-cut in underground workings on the productive lodes is sufficient to prove that the occurrence of the metalliferous ores in other than the recognised directions must be extremely rare.

The north-and-south veins are rather frequently dislocated by normal faults, known to the miners as 'slides,' which usually strike about E. 20° N.—W. 20° S., or approximately at right angles to the metalliferous vein. Several of these have been observed in the Laxey Mine (see p. 521) and others at Ballacorkish (p. 527), Snaefell (p. 535) and one or two other places (pp. 528, 532). The amount of vertical displacement which they represent is as a rule small; but if the disturbances by which the Laxey vein is lost southward, and by which the Ballacorkish vein is broken at the "Great Douk Lode," be due to faulting, these cases may be of great extent. It is not clear whether the north-and-south lodes received their metalliferous infilling before or after these transverse dislocations took place; with one supposed exception (p. 522) the 'slides' have never been found to contain ore, but some of the facts at Laxey suggest that the principal deposition of the metals took place there subsequent to the faulting of the lode (p. 522).

At Foxdale, while the chief productive lode strikes east and west, this intersects north-and-south metalliferous veins, both in the central portion of its course, and farther west at Beckwith's Mine; and in the latter case the E.—W. lode is said to have thrown the N.—S. lode at the intersection (p. 505), thus playing the rôle of a 'slide.' In the Foxdale Mines slickensided surfaces are abundant, and the striations are generally nearly horizontal, showing that some degree of lateral movement has taken place along the line of the lode; moreover, the metalliferous vein-stuff is in places broken up, sometimes into partially rounded blocks, and recemented by undisturbed material subsequently introduced, showing that there has been movement along the fissure after an interval of quiescence.

It seems possible that the later movement may have taken place here at the time of the cross-faulting of the N.—S. lodes

in other districts, and that the Foxdale vein was affected along, and not across its course because of its E.—W. direction.

A point of importance in regard to the position of the lodes is, that all the larger and more productive, including Bradda, Ballacorkish, Foxdale, Laxey, and Maughold Head, occur on or in the vicinity of the structural axis of the Manx slates, near where the dominant dips of the folded strata and of the cleavage form an anticline. As elsewhere shown (p. 118), this axis is probably the centre of a synclinalorium of the slates as a whole; but it is remarkable that in many mining districts abroad, *e.g.*, in Nova Scotia and Queensland,¹ a close association of metalliferous deposits with anticlines of folded strata has been observed, though not in veins of the Manx character.

Age of the metalliferous lodes and relation to the Olivine-dolerite dykes.

While from the limited range of Manx stratigraphy direct evidence as to the period at which the metalliferous fissures were formed is not forthcoming, we possess sufficient data to show that it must have been comparatively late in the geological history of the Island. It was certainly later than all the Pre-Carboniferous earth-movements and dyke-injections described in a previous chapter (p. 71–2), by which the Slate Series was packed into folds, brecciated, foreshortened by overthrusts, and interpenetrated by basic and afterwards by granitic intrusions.

The segregation-veins of quartz and other minerals which were formed so abundantly during the later stages of these movements contain no metals of economic value; and the metalliferous fissures have been cleanly gashed through rocks in which all the above indications of earth-movement are present, and are clearly subsequent. The presence of copper pyrites in a vein in the Carboniferous Basement Conglomerate at Langness (p. 538), and of galena in a similar vein in the Carboniferous Limestone at Castletown (p. 537), brings down the date of, at any rate, some of the metalliferous deposits into Post-Carboniferous times. The only 'solid' rocks newer than Carboniferous accessible to observation above sea-level in the Isle of Man are the intrusive dykes of olivine-dolerite, which, on grounds already discussed (Chap. VIII, p. 327), are believed to be of Tertiary age. The study of the relationship of these dykes to the lodes has led me to the unexpected conclusion that, although the fissures were in existence before the date of these intrusions, some part of their metalliferous infilling was of later date. The grounds for this conclusion are fully stated in the descriptive details of the Bradda, Ballacorkish, Langness, East Foxdale and other mines, and will here be only briefly recapitulated.

At North Bradda, Ballacorkish, and Langness there is evidence to show that dolerite dykes, following the usual north-westerly

¹ Victoria Government Blue-book; Dept. of Mines; Reports on the Bendigo Gold-field, by E. J. Dunn, pp. 9–13 (Melbourne, 1896).

course, have been diverted northward for a short space on intersecting the fissures. In the first-mentioned place, where the lode is of great size and clearly revealed in the cliff, it is seen that the dyke is intrusive into the vein. But at Ballacorkish and East Foxdale, portions of the metalliferous lodes have been found in the underground workings to intersect the igneous rock (see Smyth's reports quoted on pp. 515 and 534), and the ores (sulphides) lie alongside the margin of the dyke-rock, in positions which they could not have occupied before or during the injection of the molten matter; and similarly at Langness, where the ore slightly interpenetrates the dolerite. Besides the places above mentioned, smaller quantities of the metalliferous ores have been found in the vicinity of olivine-dolerite dykes at Kerroo-mooar (p. 546), Glen Auldyn (p. 545), Maughold Head (p. 541), and Castletown Harbour (p. 537); but in all except the last case no evidence is now available as to the exact relationship.

It is of course possible that scattered ores already in existence in the fissures may have been displaced and concentrated into larger bodies by the invasion of the dykes; but it seems more likely that the deep-seated channels which permitted the upward egress of the molten rock may also have served, at a somewhat later stage of the same period of thermal activity, as conduits for the vapours and waters which supplied the crystalline infilling to the reopened fissures.¹

It does not follow, however, that the whole of the Manx metalliferous veins are of this age; for it is only in a few instances, and these not of the first importance, that the connection between the dolerite and the ores has been observed; and, moreover, the majority of the olivine-dolerite dykes are not known to be accompanied by ore-deposits. All that can be learned from the evidence is that where the dykes of this late age are in contact with the metalliferous accumulations, the latter are the newer. As no association of olivine-dolerite dykes with ore deposits appears to be known in Western Scotland and Northern Ireland where these intrusions are so numerous, there must be some additional factor in the local conditions of the Isle of Man which has favoured the production of the metals in the veins. What this may be has not yet been discovered.

The outcropping of the metalliferous veins and of the dolerite dykes at the present surface shows how extensive must have been the erosion in the area during later Tertiary times, as the infilling of the fissures in both cases can only have occurred at some considerable depth.

I was not aware until after the above passages were written that my colleague, Mr. J. G. Goodchild, had some time ago reached a similar conclusion in regard to the metalliferous veins of another district by a different chain of reasoning. The

¹ Sir W. W. Smyth's description of the quiet and undisturbed condition of the delicate fibres of Plumosite in the Foxdale lode, quoted on p. 503, has a direct bearing on this question.

following quotation from his suggestive paper entitled "Some Observations upon the Mode of Occurrence and the Genesis of the Metalliferous Deposits,"¹ will show that the Manx evidence is in close agreement with his results.

"As bearing upon the age of the North of England lead-veins one or two points remain to be considered. The faults wherein the veins occur probably date back in many cases to very remote geological periods. As zones of disturbance and of dislocation, many of them certainly may be referred to periods long anterior to the date of the rocks they now affect at the surface. There is plenty of evidence to show that, as zones of weakness, they have acted as faults again and again at various periods since. The fault breccias are scrunched and slickensided in a manner that points to the repeated exertion of powerful mechanical forces in times past. In remarkable contrast to this evidence of powerful grinding and crushing is that afforded by the crystalline contents of the veins. There may be, in a few instances, some kind of evidence of these vein-minerals having been disturbed since they were formed; but as a rule the evidence tends to show that since the date of formation of these minerals there has been no vertical displacement of the opposite cheeks of the fault. Large masses of crystals occur without the slightest sign of any break during their growth from first to last, and the crystalline faces of many of the minerals, such as Fluor, Baryte, Galena and others, are just as perfect as when the minerals were first formed. The significance of this very common feature of mineral veins does not seem to have been generally perceived."

"Another equally well-known feature in connection with mineral veins calls for remark here. This is the 'comby' structure of lodes, and the evidence of the deposition of vein minerals in successive layers. This clearly points to the fact that during the filling of the vein there were occasional interruptions of deposition, which were contemporaneous with more or less lateral disruption of the veins and their contents. After the formation of the earliest stages of the comby structure there has been no displacement along the plane of the fault."

"Such a condition of things, extending over a large area, can only have obtained under conditions of upheaval. This seems to indicate that the introduction of the lead ores of the North of England took place at, or about the close of, the last period of upheaval. This, by independent reasoning, I have inferred to be contemporaneous with the last manifestations of volcanic energy in Tertiary times; and all the evidence yet brought forward seems uniformly to support that conclusion" (pp. 56, 57).

In many other parts of the world it has been proved that certain metalliferous veins have received their infilling at comparatively late periods in geological history and in association with the intrusion of igneous rocks. If we take, for example, Part III. (Economic Geology) of the 18th Annual Report of the U.S.

¹ Proc. Geologists' Assoc., vol. xi. (1888-9), pp. 45-68.

Geological Survey, which came to hand while this chapter was in preparation, we find an account (p. 69) of the celebrated Treadwell-Mexican Gold Mine on Douglas Island, Alaska, by G. F. Becker, in which it is stated that the mineralization of the lode is probably connected with the intrusion into it of a vein of analcite-basalt, the author concluding that "the basalt was injected after the mineralization began, but before it had ceased"; he adds, "so far as I know this is the first known case of an association of analcite-basalt with ore generation." The age of the intrusion is not definitely established, but is supposed to be either Late Mesozoic or Tertiary.

Moreover, in the same volume three out of the four other reports on mining districts, in widely separated parts of the Western States, embody the conclusion that the metalliferous infilling of the veins must be assigned to periods of eruptive activity in Tertiary (or in one case possibly Cretaceous) times: these are "On the Judith Mountains of Montana," by W. H. Weed and L. V. Pirsson (veins not older than early Tertiary, p. 463); "On the mining districts of the Idaho Basin," by W. Lindgren (veins probably Cretaceous or early Tertiary, p. 631); and "On the Telluride Quadrangle, Colorado," by C. W. Purington (veins not older than Late Tertiary, p. 825).

'Country'-rock of the Lodes.

The Manx metalliferous veins are developed principally in that portion of the Manx Slate Series which is intermediate in character between the grits on the one hand and the clay-slates on the other. Their usual matrix is the bluish-grey thin-bedded flags or flaggy slates which consist of a more or less intimate admixture of argillaceous and fine-grained sandy or silty material. In no case has a productive lode been found among the quartz-veined grits ("Agneash and other Grits," of published map); and where belts of this character have been encountered in underground workings, as at North Laxey and in the northern extremity of Great Laxey, the vein has been found to contract or become 'tight,' and to lose its value. On the other hand the homogeneous dark-blue "Barrule Slates" have been found equally barren; and where bands of this composition have been passed through, as at Snaefell and other places, the lode has become soft ('douky') and shattered, splitting up into small branches and losing its individuality. At Foxdale the main E. and W. lode, and also one of the N. and S. cross-courses (Magee's), has been followed downward from the slate into granite, and has been found equally as productive in the one rock as in the other, though the quality of the galena has shown a remarkable variation, that in the slate being richer in silver than that in the granite.

In this locality the opinion, alluded to by Cumming,¹ is commonly held that the metalliferous vein owes its riches to the

¹ "Isle of Man," p. 308.

granitic intrusion. But it is clear not only that the granite was consolidated, but also that its offshoots were affected by post-consolidation movements (p. 316) long before the lode was formed. Similarly at Laxey, the lode cuts across elvans given off from the Dhoon Granite, in which incipient cleavage had been produced by earth-movement subsequent to their consolidation (p. 521); and at the old Cornelly Mine, a mile N. of Foxdale, where massive granite was found beneath the slate (p. 517), the lode traversed both rocks. At Bradda, Ballacorkish, Snaefell, and North Laxey, considerable ore bodies occur in the slate-rocks where there is no reason to suspect the proximity of granitic intrusions; and the highly productive western portion of the Foxdale main lode, (Beckwith's Mine, p. 504), lies amid slates nearly 2 miles beyond the proved underground extension of the granite. The rich vein at Laxey, again, is about a mile distant from the nearest outcrop of the Dhoon Granite; while other veins in close proximity to that intrusion have proved barren or nearly so (p. 528). Hence the whole of the facts tell against the supposition that the metalliferous deposits were a direct result of the granitic eruptions.

In an indirect manner, however, it is possible that the Foxdale Granite, long after its consolidation, may have favoured the production of the lode, by affording a massive homogeneous rock-basement, in which a fissure produced by unequal earth-movement might descend to great depths and remain sufficiently open to permit the ascent along it of the vapours and solutions from which the empty spaces received their infilling. The broad shelving laccolitic outline of this granite (p. 166) would be more favourable to the production of such a fissure than would be the case in the Dhoon Granite, which appears to descend as an irregular pipe-like core with steep walls (p. 144).

The same explanation may be applied to the distribution of the veins in the sedimentary rocks. Where these were of a character to break cleanly to considerable depths, and to preserve an open space when fissured, as in the case of the firmly packed and welded mass of Lonan flags enclosing the Laxey lode, productive metalliferous veins have been formed: but where the rocks were, like the Agneash Grits, of such a character that regular fissures could not readily be produced in them; or, like the Barrule Slates, where if produced, such fissures would be filled with the broken débris of the walls, the conditions were unfavourable either for the percolation or deposition of the ore-bearing solutions, and the veins are consequently scanty and of no economic value. This explanation seems adequate for the known occurrences of ore in the Island; but fails to account for the fact that there are large tracts of the firm slaty flags apparently equally favourable for the production of lode-conditions, in which only inconsiderable quantities of ore have yet been discovered. Here again some additional factor in the deep-seated structure, to which we have no clue, is probably involved.

Association of the Ores in the Lodes.

On this point but little information has been obtained. The lead and zinc ores (sulphides) are usually found together; but the relative quantities are extremely variable; so that while at Laxey zinc-blende is by far the most abundant ore, at Foxdale the quantity present is too insignificant to be recognised commercially. Copper, in the form of pyrites, generally occurs, in very thin strings or finely disseminated around the outskirts of the other ore-bodies, as at Laxey, where its appearance in the southward drivings heralded the deterioration, of the lode (see p. 520); at Foxdale it is rarely found and in very small quantities (see Smyth's report in 1883 quoted on p. 511). Pyrites and chalybite are more or less present in all the lodes, the latter sometimes in large bodies at Foxdale.

The hematite ore of the Maughold veins, as suggested on p. 291, may have been introduced into the lode when the slates were overlapped by Triassic strata.

Lists of the minerals of the individual lodes and particulars respecting the rarer varieties are given in the subsequent detailed descriptions of the mines.

Notes on the Mineral Statistics since 1845.

After the close and systematic search which has been made in every part of the Island, we may presume that the relative importance of the various lodes has been well established, and that no considerable body of ore presenting surface indications can have been overlooked, though there is, of course, the possibility that such may remain still undiscovered beneath a superficial covering of drift. As previously mentioned, while the valuable ores have been found in small amount in many veins, the commercially successful mines are and apparently have always been confined to two lodes—that of Foxdale and that of Laxey, though considerable bodies of lead and zinc ore have been met with also in the mines of 'Snaefell,' 'North Laxey' in the Cornah Valley, and 'Ballacorkish'; and of hematite in Maughold parish. From all the other workings combined the total quantity is inconsiderable. From the depth to which the principal mines have now been sunk, we must also conclude that the average output of the last fifty years is unlikely to be maintained in the future.

LEAD-ORE.—The table given on pp. 495-8 shows that between 1845 and 1850 the average output of lead-ore was 2,300 tons per annum, of which at first six-sevenths, and afterwards two-thirds was contributed by the Foxdale group of mines, and practically the remainder by Laxey. A steady increase during the next five years brought the total output of this ore in 1855 up to 3,573 tons, of which three-fourths was from Foxdale, and the remainder

from Laxey. A decrease then set in, so that until 1864 the annual output ranged, in round numbers, between 2,500 and 2,800 tons. In that year however the contribution from Laxey was greatly augmented; and in the following year equalled that of Foxdale, bringing the total up to 3,143 tons of lead-ore. In 1871 the grand total of 4,645 tons was reached, of which Laxey yielded a half, Foxdale rather over a third, and eight smaller mines the remaining sixth. There was a drop of 1,000 tons in 1872 owing to a decrease of that amount from Laxey; but from 1873 to 1877 inclusive the total annual output of the Island remained steadily between 4,200 and 4,400 tons, the Foxdale contribution maintaining, as for many previous years, remarkable regularity at about 1,600 to 1,700 tons. In 1878 the returns fell below 4,000 tons, Laxey sinking again, and permanently, to the second place as a lead-producer. But this deficiency was more than made up in succeeding years by Foxdale, which swelled the output to high-water mark at 6,868 tons in 1885, two-thirds of which was from this mine and less than a quarter from Laxey. From 1884 to 1893 inclusive the total yield of lead-ore remained between 6,000 and 6,700 tons, the decline of Laxey meanwhile continuing, so that in the last-named year its proportion was less than one-seventh, while Foxdale yielded three-fourths and three other mines the remainder. Since that date, though Foxdale has maintained its high productiveness—its yield of 4,800 tons of lead-ore for 1894 being the greatest in the history of the mine—the deficiency from the other mines has diminished the total output of the Island to 3,843 tons for 1900.

ZINC-BLENDE.—The only other metal deserving special notice is zinc; and its history is practically that of the Laxey Mine, as except during a short period of productiveness at Snæfell, the other sources of this substance in the Island have been unimportant. In 1854 the returns of blende from Laxey were 1,435 tons, rising suddenly in the following year to 3,989 tons, and from that time until 1861 ranging around 3,000 tons more or less. Then follow great fluctuations, so characteristic of this mine, the record for 1862 being 691 tons; for 1863, 2,298 tons; for the four following years, between 4,960 and 5,488 tons; in 1869, 7,208 tons; and so on, until in 1875 the returns show 11,753 tons of blende from this mine, and 11,898 tons from the whole Island, a quantity which has not been since attained.

During the ensuing decade, the average was about 6,000 tons, ranging from about 2,000 above to 2,000 below this figure. But since 1885 there has been a continued decline which brought down the total for 1896 to 1,180 tons of blende from Laxey and 1,489 tons from the whole Island, with a slight recovery to the total of 2,009 tons in 1897, 2,602 tons in 1899, and 2,124 tons in 1900.

The following table gives the total annual output of the Manx Mines recorded in official returns.

ISLE OF MAN MINING STATISTICS.

TABLE showing TOTAL OUTPUT OF MANX MINES.¹

Year	1826	1827	1828	1829	1830	1831	1832	1833	1834	1835	1836	1837	1838	1839	1840	1841	1842	1843	1844
Lead ore (containing silver, as below).	Tons.	—	—	—	—	—	—	Tons: No returns	Tons. available	Tons. before	Tons. 1845.	Tons.	—	—	—	—	—	—	—
Zinc ore	—	—	—	—	—	—	—	No returns	available	before	1854.	—	—	—	—	—	—	—	—
Copper ore ²	33	—	25	161	238	233	341	249	268	77	89	69	121	133	276	368	406	207	46
Iron ore	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Umber, Ochre, etc.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Silver, estimated quantity contained in lead ore	—	—	—	—	—	—	—	No returns	available	before	1851.	—	—	—	—	—	—	—	—

¹ Compiled from Mem. Geol. Survey, vol. ii. (1848), pp. 703-715; Records of the School of Mines, vol. i. (1853), pt. 4; Mineral Statistics, 1853-1893.² The figures for the first twenty-two years are derived from "Sales at Swansea from English Mines," Mem. Geol. Survey, vol. ii. p. 715.

ISLE OF MAN MINING STATISTICS.—Continued.

TABLE showing TOTAL OUTPUT OF MANX MINES.

Year	1845	1846	1847	1848	1849	1850	1851	1852	1853	1854	1855	1856	1857	1858	1859	1860	1861	1862
	<i>Tons.</i>	<i>Tons.</i>	<i>Tons.</i>	<i>Tons.</i>	<i>Tons.</i>	<i>Tons.</i>	<i>Tons.</i>	<i>Tons.</i>	<i>Tons.</i>	<i>Tons.</i>	<i>Tons.</i>	<i>Tons.</i>	<i>Tons.</i>	<i>Tons.</i>	<i>Tons.</i>	<i>Tons.</i>	<i>Tons.</i>	<i>Tons.</i>
Lead ore (containing silver, as below).	2,259	2,316	2,575	2,521	2,826	2,175	2,560	2,415	2,460	2,800	3,573	3,213	2,656	2,457	2,464	2,810	2,718	2,508
Zinc ore	—	—	—	—	—	—	—	—	—	1,435	3,990	3,000	2,917	2,777	—	3,181	3,255	691
Copper ore	79	92	60	—	—	—	—	—	—	64	—	125	280	403	354	350	785	942
Iron ore	—	—	—	—	—	—	—	—	—	—	2,240*	—	—	566*	1,282*	1,671*	967*	647*
Umbre, Ochre, etc.	—	—	—	—	—	—	—	—	—	164	—	161	—	120	—	—	116	—
Silver, estimated quantity contained in lead ore.	—	—	—	—	—	—	33,980	36,700	47,105	52,262	52,203	60,392	43,016	46,985	56,974	60,170	67,282	70,592

* Hematite.

ISLE OF MAN MINING STATISTICS.—Continued.

TABLE showing TOTAL OUTPUT OF MANX MINES.

Year	1863	1864	1865	1866	1867	1868	1869	1870	1871	1872	1873	1874	1875	1876	1877	1878	1879	1880
Lead ore (containing silver, as below).	Tons. 2,561	Tons. 3,118	Tons. 3,143	Tons. 3,494	Tons. 3,789	Tons. 4,290	Tons. 4,302	Tons. 4,604	Tons. 4,645	Tons. 3,529	Tons. 4,371	Tons. 4,204	Tons. 4,429	Tons. 4,353	Tons. 4,464	Tons. 3,920	Tons. 4,368	Tons. 5,119
Zinc ore - - -	2,298	5,363	5,458	4,960	5,361	3,278	7,219	4,177	5,768	3,123	5,520	7,010	11,898	9,669	9,043	9,569	7,427	7,507
Copper ore - - -	1,293	127	1,317	294	400	462	459	373	180	323	-	61	-	75	52	30	20	35
Iron ore - - -	839*	-	120*	-	-	220*	1,291*	-	75†	122† 572*	512† 2,256*	718† 425*	-	-	-	100†	280†	9†
Umber, Ochre, etc. -	-	-	-	130	-	140	139	142	172	148	248	156	183	-	170	232	156	166
Silver, estimated quantity contained in lead ore.	Oz. 74,289	Oz. 125,030	Oz. 123,221	Oz. 147,516	Oz. 165,170	Oz. 178,718	Oz. 173,839	Oz. 175,528	Oz. 176,631	Oz. 145,433	Oz. 163,068	Oz. 161,612	Oz. 168,524	Oz. 170,105	Oz. 186,019	Oz. 110,496	Oz. 100,476	Oz. 59,867

* Hematite.

† Spathose iron ore.

ISLE OF MAN MINING STATISTICS.—Continued.

TABLE showing TOTAL OUTPUT OF MANX MINES.

Year	1881	1882	1883	1884	1885	1886	1887	1888	1889	1890	1891	1892	1893	1894	1895	1896	1897	1898	1899	1900.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
Lead ore (containing silver, as below).	5,675	5,494	5,928	6,007	6,868	6,257	6,560	6,356	6,433	6,141	6,632	6,698	6,427	5,624	5,287	4,953	4,273	3,943	3,324	3,343
Zinc ore	7,567	7,756	4,820	5,685	5,510	4,795	4,994	5,320	4,596	4,393	3,561	3,380	3,628	2,579	1,535	1,489	2,009	2,135	2,602	2,124
Copper ore	60	44	578	—	236	—	—	46	—	7	—	4	—	—	—	—	—	—	—	—
Iron ore	120†	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Umber, Ochre, etc.	207	171	188	—	—	—	—	—	—	No Returns.	—	—	—	—	—	—	—	—	—	—
Silver, estimated quantity contained in lead ore.	Oz. 84,865	Oz. 19,769	Oz. 125,940	Oz. 123,251	Oz. 132,315	Oz. 125,456	Oz. 134,353	Oz. 138,083	Oz. 130,304	Oz. 129,124	Oz. 136,850	Oz. 124,949	Oz. 122,010	Oz. 111,325	Oz. 150,302	Oz. 107,643	Oz. 91,710	Oz. 76,419	Oz. 72,431	Oz. 66,067

† Spatiouse iron ore.

MINING DETAILS.

List of Mines and Mining Trials in their order as described in the following pages. The names of the more important are printed in small capitals.

Foxdale Group.

BECKWITH'S VEIN.	EAST OR CENTRAL FOXDALE
Cross's Vein.	MINE.
Dixon's Vein.	Ellerslie, Glen Darragh, Bishops
OLD FOXDALE.	Barony, or Great East Foxdale
Magee's Mine.	Mine.
Old Flappy Vein.	CORNELLY OR TOWNSEND MINE.
Hodgson's or Faragher's Mine.	Ballanicholas Mine.
	Garth Trial.

Laxey Group.

GREAT LAXEY MINE.	SNÆFELL MINE.
NORTH LAXEY AND GLENCHERRY	Block Eary Trial.
MINES.	Glen Roy Mine.
East Laxey Trial.	Dhoon or Rhennie Laxey Mine.
East Snæfell Trial.	

Southern Group.

BRADDA OR SOUTH MANX MINES.	Iron Spout Trial.
BALLACORKISH, RUSHEN, OR	Glenchass Mine.
SOUTH FOXDALE MINES.	West Bradda Trial.
Ballasherlocke or Bellabbey and	Castletown Harbour Vein.
Falcon Cliff Mine.	Langness Copper Mines.

Northern Hematite Group.

MAUGHOLD HEAD, GLEBE VEIN,	BALLAJORA (BALLAGORRA) AND
AND DRYNANE MINES.	MARBRICK (MAGHER-E-BRECK)
	MINES.
	Ballasaig and other Trials.

Miscellaneous Trials.

Abbey Lands Mine.	Glen Rushen and Niarbyl Mine.
Ballaglass and Ballaskeg, or Great	Ingebreck Mine.
Mona Mine.	Kerroomooar Mine.
Barony Mine.	Kirk Michael Mine.
Baldwin Mine.	Laurel Bank and Wheal Michael
East Baldwin or Ohio Mine.	Mine.
Douglas Head Mine.	Maughold Head Copper Mine.
Ellan Vannin or Cartwright's Glen	Montpellier Mine.
Mine.	Mount Dalby Mine.
Glen Auldyn Mine.	Onchan or Douglas Bay Mine.
Glen Crammag Mine.	Pen y Phot Mine.
Glenfaba Mine.	Ramsey or Northern Mine.
Glen Meay, or North Foxdale,	
Mine.	

Notes on other vein-products.

Gold.	Plumbago.
Molybdenite.	

FOXDALE GROUP.

The Mines of the Central or Foxdale Area.

HISTORICAL AND GENERAL NOTES.

From both the geological and economic points of view the Foxdale Mines stand pre-eminent in the Isle of Man; during the latter half of the past century they have indeed attained to the first rank among the lead-mines of the United Kingdom for productiveness, as well as for good management, which has enabled them to survive successfully the vicissitudes in the market value of their product that have extinguished the industry in many mining districts. They are situated in the interior of the southern part of the Island, close to the head-waters of the Foxdale River. The east-and-west lode which they explore traverses the northern slopes of South Barrule and Granite Mountain (formerly known as Slieau ny Clough), the present workings being confined to the portion intersecting the village of Foxdale, at an elevation of from 400 to 450 feet above sea-level.

The date of the first discovery of ore in this locality is not known, but was at any rate before the early part of the 18th century, as in a report made to Lord Derby in 1724 the governor of the Island mentions that "Foxdayle hath from the first been worked with the least success . . . I shall be forced to give it up, for the longer we work it the worser it grows."¹

Since the surrounding ground is more or less drift-covered, we may presume that the lode was first recognised in the bed of the Foxdale River, which crosses its richest portion. Old workings may still be traced in the vicinity of the stream; and it was probably these to which Feltham referred in 1798 as having produced rich and abundant ore,² and which Woods noticed early in the next century, in a deserted condition, "the rubbish from the shafts consisting almost wholly of fragments of slate, mixed with pieces of brown blende, a little lead glance and some sparry iron ore." ("Account of . . . the Isle of Man," 1811, p. 12.) Berger also found the mines inactive (in 1811?); he mentions that a "small-grained granite" had been found in one of the shafts, and that a productive north and south cross-vein (see p. 510) had been discovered, with richer ore at its junction with the main vein. He was informed that the granite was found in a shaft 40 yards deep, where it "formed the north side of the vein, the galena adhering to it, while the south side was a stratified rock."³ Macculloch, a few years later, likewise found the workings deserted and inaccessible.⁴

Some information regarding these old workings has been obtained from documents preserved in the Office of Woods and Forests. In a schedule of the property purchased by the Crown from the Duke of Athol in 1827-1828, we find under the heading of Lead-mines "*New Foxdale*," "Old Foxdale," and "Flappy Vein" (the cross-course mentioned by Berger), given as three distinct mines; and it is mentioned that these are subject to a lease granted by the Duke to Michael Knott for a term of 31 years from November, 1823. There is also in the same office an old plan and section prepared by J. A. Twigg in 1826, the former lettered, "Section of the vein of lead-ore at the New Foxdale Mine, wrought by M. Knott, Esq., in the Isle of Man, showing the course of the levels (driven near the vein) and a view of the shafts at present sunk, and also some trials made upon the Head of the vein at the Surface." This plan shows the Engine Shaft to be 38 fathoms deep, with two levels west and five levels east from it; the longest level was that at 15 fathoms, which went 160 fathoms east and was reached by

¹ Knowsley (Loose) Papers quoted by A. W. Moore in "History of the Isle of Man," vol. ii. p. 964.

² "Tour through the Isle of Man," p. 213.

³ Trans. Geol. Soc., vol. ii. (1814), p. 37 and p. 52.

⁴ Western Isles," vol. ii., p. 577 (1819).

three air-shafts E. of Engine Shaft, and by one W. of it; and still farther E. were two more sinkings, to a depth of 15 fathoms, with short drivings. The ground-plan indicates the main lode, with a "south string" and "north string" [? = Magee's Lode, see p. 510], just east of Engine Shaft: and a "strong vein" [? = Flappy Vein] going off nearly N.-S. on the west of Engine Shaft; and also an E.-W. vein joining the "main vein" 33 fathoms west of that shaft, on which is the note "This vein contains manganese and other minerals not congenial to lead." It shows, moreover, the position of "shaft sunk by the old men," and "old workings wrought 40 years ago."

Soon after Mr. Knott obtained his lease he appears to have sold his interest to a company, who took up the working; and thenceforward, on one part or another of the vein, mining has gone on continuously up to the present day. The following account of the progress of the mine up to 1848 is given by Cumming:—

"The chief workings at that time [*i.e.*, circa 1823] were upon what is generally termed the Foxdale vein, to the northward of the great granitic boss, crossed by elvans striking out from the nucleus of the granite. Very little except horse and water power had been employed, though there were at that time two small steam-engines also at work, and the depth reached was never more than 40 fathoms. The great workings are now carried on [circa 1848] at the eastern and western extremities of the district, at Cornelly or Jones vein [see p. 516] in the neighbourhood of Kenna, and at the Beckwith vein in Glen Rushen. The Cronck Vane¹ mine, more in the centre of the district, on the brow of the hill betwixt Slieauwhallin and South Barrule, a few years ago was worked with very great results. The miners appear to have fallen in with one of those great sops or masses of ore which I have noticed in the body of this work as generally characteristic of limestone districts, but which appears as a peculiar feature of this schistose country also."

"At the time of my visit, in company with Professor Ansted, three years ago, the depth attained into the body of ore was 88 fathoms, the width of the vein or mass at its centre being 24 feet, thinning off to the E. and W. to about 4 feet. The length of this body of productive ore was 14 fathoms. The vein had generally a southerly dip, the walls being very clean, and presenting in several places extensive appearances of slickenside. There is very little gossan upon these veins, and not in general any indication of their presence till the workman comes directly upon the body of lead. The prediction of Professor Ansted at that time, respecting the duration of the working at the Cronck Vane Mine, seems to have been fully verified, as I found on my last visit to the place the works abandoned."

"The number of men and boys employed at the mines of this company in different parts of the district is generally about 350, and the average raising of ore for the last ten years has been about 2,400 tons per annum. The product gives about 70 per cent. for lead and 9 ozs. silver per ton."²

Since the above was written, the operations on the eastern and western extremities of the Foxdale lode and on the Cornelly (afterwards known as Townsend) vein have gradually been suspended; and for many years past, work has been confined to deep mining on the site of the earliest workings close to Foxdale village. An admirable record of the later history of the mines of the district is contained in the series of reports made annually between the years 1857 and 1888 by Mr. (Sir) W. W. Smyth, as the result of his personal examination; these are preserved in manuscript at the London Office of Woods and Forests, and in the context will be largely drawn upon for information respecting workings which are now inaccessible.

In 1867, D. Forbes in describing³ the occurrence of Polytelite (Silber

¹ This refers to Cross's Mine (Cross Vein of 6-inch Ordnance Map, Sh. 12 $\frac{1}{2}$ mile west of Doarlish Head.

² "Isle of Man," p. 309.

³ "Researches in British Mineralogy," Phil. Mag., 4th ser., vol. xxxiv., pp. 350-4.

fahlerz) from the Foxdale mines, gave a short account of the character of the lode. He stated, on the authority of Mr. J. L. Thomas, that the polytelite occurred in the most easterly workings of the mine where the lode ran out of slate into granite, the minerals associated with it being galena, chalcopryite, iron-pyrites, zinc-blende, quartz, dolomite, chalybite and calcite. Mr. Forbes gave an analysis of the polytelite, showing it to contain 13·57 per cent. of silver. His remarks on the granite and on the reported occurrence of gold in the locality will be alluded to on a subsequent page (p. 549).

In 1880 Mr. (Sir) W. W. Smyth gave an account of the general features of the lode in a paper "On the occurrence of Feather Ore (Plumosite) in Foxdale Mine."¹ The following passages are quoted from this paper as supplying an excellent and authoritative description of the vein and its rare mineral, plumosite:—

"The masterly lode of Foxdale has been worked for some four miles, not quite continuously, on its east and west course, and to an extreme depth nearly approaching 200 fathoms" [since carried to 290 fathoms, see seq.]. "It varies in character, and often within short distances, to as great an extent as perhaps any lode that could be cited; sometimes, as at Beckwiths, a body of more or less ore material of 5 or 6 fathoms in width, in other parts exhibiting powerful ribs of solid galena with several tons of ore to the running fathom, again parting into parallel branches of an ordinary lead ore on the south wall, and others of a highly argentiferous variety affecting the north side, and often with from 2 to 6 fathoms of lode material between them. Between the courses and shoots of ore is encountered (and sometimes unfortunately for very long distances) a quantity of unproductive ground in which detrital killas, or granite, and ribs of chalybite (carbonate of iron), and singular veins and seams of an indurated black clay, form the chief constituents. This latter material, cutting sharply against some of the other lighter coloured substances, gives rise to appearances very instructive as regards successive openings and fillings of parts of the lode, and reminds one of the so-called *glauk*, which plays a similar part in the small but rich veins of tellurium and gold at Nagyag in Transylvania."

"Furthermore, the variation in appearance is added to by the fact that whilst the country rock has mostly been killas, the Old Foxdale Mine encountered granite at a medium depth—in some places only on one wall, and is now opening in many successive levels in a solid mass of that rock. No sudden alteration has been produced by the change of 'country'; but fluor spar is abundant in some of the western drivings, and in the deeper levels the main or south part of the lode appears to be more frequently than elsewhere a matrix of grey quartz. In these deeper levels a new and unusual feature has been the emanation of a gas, probably carbonic acid, from the crevices of the south wall of the lode, which has the effect of instantly quenching the flame of the candle, and at times had interfered with the work for days together."

"The chief engine shaft is Bawdens, and to the west of this, 10 to 20 fathoms, about the 100-fathom level, in a series of 'pitches' extending up to the 86, soon above which the killas comes in as 'country,' is the part of the mine in which the Plumosite has been found. Its *habitat* appears to be on the north side of the south part of the great lode. In other portions of the mine, about the 'old shaft' further east than the above, the well known antimonial ore of copper, called fahlerz or tetrahedrite, has been met with in spots and branches, notably at the 100 and 115-fathom levels; and the frequent tendency of this mineral to contain a large percentage of silver has no doubt had something to do with the unusual value for silver of the galena of some of the northern parts of the lode. These have in fact assayed at times from 100 to above 200 oz. of silver to the ton of lead, and have thus in many places admitted of being worked in thin strings, and in hard ground, where common lead-ore would not have paid to work. It might have been expected that the two antimonial minerals, the fahlerz and the plumosite,

¹ Trans. Roy. Geol. Soc. of Cornwall, vol. x., pp. 82-89.

would stand in some relation to each other. It is true they both occur at nearly the same level; but where the latter has been found there is no trace of the former."

"The plumosite is associated with a fine-grained galena, and a vuggy or cellular quartz, with many transparent crystals; it occupies these vugs, seldom filling them up entirely, but usually attached by one portion, whilst the remainder floats loosely. Its appearance is much like that of a piece of dark cotton wool, sometimes like a little wreath of smoke.

A closer examination will reveal multitudes of the finest spiculae, bright grey metallic-lustred hairs confusedly flung together, and sometimes so felted into one plane, the prisms crossing in different directions, as to look like a bit of rag or woven cloth. The colour, however, is always grey, and hence differs at once from the *Zundererz* or Tinder ore of the German mines, in which a notable proportion of silver, about 2.56 per cent., is revealed by the reddish colour due to an admixture of the mineral, Ruby silver ore. One or two of the specimens had a slight touch of that dull red colour which characterises the *Zundererz*; but in view of the minute quantity of the mineral it is difficult to decide whether the redness may be due to one of the 'ruby silvers' or to kermesite."

"Under the microscope the prisms come out distinctly; but it is difficult to be satisfied about their terminal faces. Other very curious features are now discernible; the hairlike prisms often affect curvilinear forms; arcs of circles and parabolas are not infrequent, and in some cases a coil of the microscopic hairs forms a perfect ring of very uniform thickness. The long crystals are flexible and elastic, and those which are anchored at one end will be seen to wave to-and fro in a current of air. Some of these are adorned with minute bright crystals set at intervals upon them like beads upon a string. These latter appear to be cubical, and may probably be pyrites. . . . I cannot but regard it as a singular circumstance, under the data which we at present possess, that this new occurrence of plumosite should be connected exclusively with galena, quartz, and their usual associates.

The plumosite is, in point of date of deposition, the last mineral which has been formed in the little caverns of the lode, and its delicate fibres and webs seem to indicate, whatever process we may call in to explain their origin, a period of quiet and undisturbed action."¹

The emanation of carbonic acid gas from the lode, referred to by Smyth in the above account, was more fully described by Dr. C. Le Neve Foster in 1883,² who noticed the phenomenon in a cross-cut in granite, 14 fathoms south, from the 185 fathom level of the mine. Dr. Foster mentions in this paper that there had been a similar issue for a fortnight from a vug in the sole of the 80 fathom level of the Townshend (Cornelly) Mine three years previously, and that small escapes of the same gas had been reported from 'lochs' in the Great Laxey Mine.

The further literature relating to the Foxdale mines includes a short general description of the lode in 1890 by Prof. W. Boyd Dawkins³; and the brief accounts to be found in most of the larger British text-books on Ore-deposits; e.g., J. A. Phillips' "Treatise on Ore Deposits," pp. 304-6 (2nd ed., London, 1896); C. Le Neve Foster's "Text-book of Ore and Stone Mining," pp. 335-8 (Lond., 1894).

While this memoir was in the press a short note on the mines by Capt. W. H. Kitto of Foxdale, read in 1892 before the Isle of Man Nat. Hist. and Antiq. Society, has been published (Yn Lioar Manninagh, vol. ii., 1901, p. 32). The following is Capt. Kitto's description of the lodes:—"There are several lodes in Old Foxdale, but the two principal bearing ones called the North and South, are very dissimilar—the former hard, with all its ore highly charged with silver, ranging from 50 to 400 ounces per ton, and

¹ Italics not in the original.

² Trans. Roy. Geol. Soc. of Cornwall, vol. x., pp. 175-6.

³ "On the clay slates and phyllites of the South of the Isle of Man, and a section of the Foxdale Mine." Trans. Manch. Geol. Soc., vol. xx., pp. 53-56.

at times having small quantities of Tetrahedrite or Fahlerz, an ore of copper and antimony averaging from 3,000 to 4,000 ounces of silver, whilst the South, or soft doukey lode, by its side yields comparatively little silver, but a greater quantity of lead ore."

With regard to the occurrence of Plumosite in the mine, Capt. Kitto gives the following additional information:—"Plumosite was first discovered in the western part of these mines at the 86 fathom level. It is associated with fine-grained galena, and a vuggy quartz, with transparent crystals; Recently we have discovered it in the eastern part of the mine, about 60 fathoms deeper, in grey quartz and killas, with both sides of the lode composed of granite. We have not found it in large quantities, and never entirely in granite, but always in the locality of lead rich in silver." (Op. cit. p. 33.)

The annual output of ore from the mines since 1845 has been published in "Mineral Statistics" and other official records, and from these sources the Table given on p. 512 has been compiled. The periodical reports of the managers of the mines, giving full details of the progress of the workings, have for some years past been reproduced *in extenso* in the local weekly newspapers published in Douglas. Files of these newspapers may be consulted in the Douglas Free Library.

DESCRIPTION OF THE WORKINGS.

The main Foxdale lode has been worked almost continuously, by a string of shafts extending from Glen Rushen on the west to a little to the eastward of Foxdale village on the east, a distance of about $2\frac{1}{2}$ miles, with outworkings, on a supposed prolongation of one of its branches at Eairy $\frac{1}{2}$ mile still farther eastward. Its leading characteristics have been given in the preceding general description and in the passages quoted from Sir W. W. Smyth's account of the mines. It has a persistent southerly underlie, and in the central portion of its course, where best defined, strikes in an average direction of E. 3° - 5° N. to W. 3° - 5° S. Both eastward and westward it splits into branches, and is lost in confused and broken ground. In spite of repeated searches (some account of which is given on pp. 546 and 548) it has not been traced west of the stream in Glen Rushen, and the most westerly working to yield a profitable quantity of ore is the Beckwith Mine, 400 yards east of that stream, at an altitude of about 650 feet above ordnance datum.

The diagram overleaf, based on the plans in the possession of the Isle of Man (Foxdale) Mining Company, will serve to show the position and depth of the shafts on the main lode, and the lie of its principal branches and cross-courses (Fig. 110.)

Beckwith's Mine.

The following account of the discovery of the riches of this temporarily productive portion of the vein was given by the late Mr. W. Beckwith under the date April 9th, 1881, and printed in the prospectus of the "New Foxdale Mining Syndicate" (Garth Trial, see p. 515):—

"The Beckwith vein was discovered by the driver of a hay-cart crossing the west side of South Barrule, who found a solid lump of lead-ore in the wheel-track; this induced me to make a search in the neighbourhood, when I discovered ore among the roots of the heather, and immediately put two men to work who, on the following day opened up the ore, and about 650 tons were raised before sinking was commenced. The ultimate result of this discovery was about 50,000 tons of lead-ore which realised about three quarters of a million sterling." "Like all veins in the Isle of Man this enormous yield was irregular in its deposit, from the surface down to the 70-fathom level the vein averaging from 10 to 15 feet wide and

producing fully 15 tons of lead-ore to the fathom. In the next 20 fathoms the vein grew poor, but on persevering with the sinking the ore was again cut into at the 90-fathom level, this new deposit being more productive than before, in places fully 26 feet wide and yielding 30 tons ore to the fathom. This great productiveness continued for another 50 fathoms down when the mine again became poor, evidently from the same causes that existed in the levels above."

In spite of its magnificent commencement, the deeper part of the mine and the lateral workings proved entirely unprofitable and it was abandoned about 1866, though an attempt was made 15 or 20 years later to form a company to restart it. The main or 'Beckwith's' shaft attained a depth of about 185 fathoms from the surface, intercepting the 'old day-level' at 15 fathoms and the 'new day-level' at about 35 fathoms, with levels at 15, 30, 45, 60, 75, 90, 102, 117, 132, and 147 fathoms below the new day-level. The ore-body seems to have been very limited in lateral extent throughout, lying chiefly to the eastward of the main shaft, having a general trend westward, and disappearing in depth below the 102 fathom level. The vein appears to be a southerly branch of the Foxdale Lode, and strikes S. 10° W., with a southerly underlie. A supposed north branch, 200 to 300 yards north of Beckwith's, striking approximately E.-W., has been recognised by the miners as the 'North Gill Lode,' and tested in several places, but without profitable result. These converging branches are supposed to fall together in the vicinity of Cross's Mine (see below). Besides these E.-W. veins, a productive cross-course striking nearly north and south (N. 3° W.), named 'Wardell's North Lode,' occurs at the Beckwith Mine, and was worked by N.-S. levels from that shaft, yielding ore chiefly between the 60 and 90 fathom levels. In view of the importance of determining the relative ages of these veins, I made special inquiry as to their intersection, and was informed by Captain J. Kitto that the N.-S. (Wardell's) lode was found to be shifted about 3 fathoms eastward on the south side by the E.-W. (Beckwith's) lode. Their relations are thus the same here as in the Laxey, Snaefell, and Ballacorkish mines where the N.-S. veins are displaced by later E.-W. 'slides' or faults; with this difference, however, that whereas the 'slides' of those mines are almost invariably barren, in this case the E.-W. vein constitutes the most productive part of the mine.

The 'country' rock of the mine is a highly-sheared sericitic striped slate, which merges westward into the dark blue homogeneous 'Barrule Slate' (p. 53) of Dalby Mountain, and eastward into a belt of alternately slaty and gritty flags. The prevalent dip of these rocks is at a high angle towards N.N.W., but in the vicinity of the lode and between its two branches north-north-easterly dips occur in several places. In the spoil-heap were noticed fragments of one of the common basic ('older greenstone') dykes crushed into a schist, but no trace of the Foxdale granite or its elvans exists in this locality. The ground around the mine is more or less drift-covered (p. 458), and it is only in the glens that the rocks are well exposed.

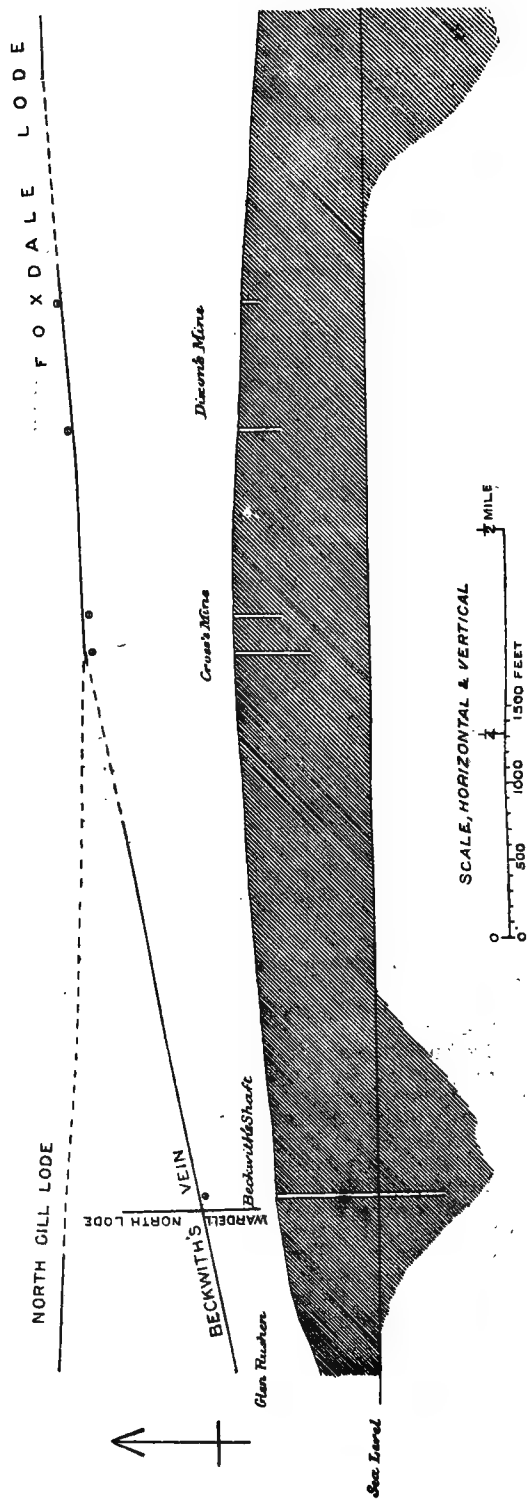
During the later stages of its activity the Beckwith mine was annually examined by Sir W. W. Smyth, and as it has now fallen to ruin and its workings are quite inaccessible, a few notes drawn from the MSS. reports of this authority may prove useful.

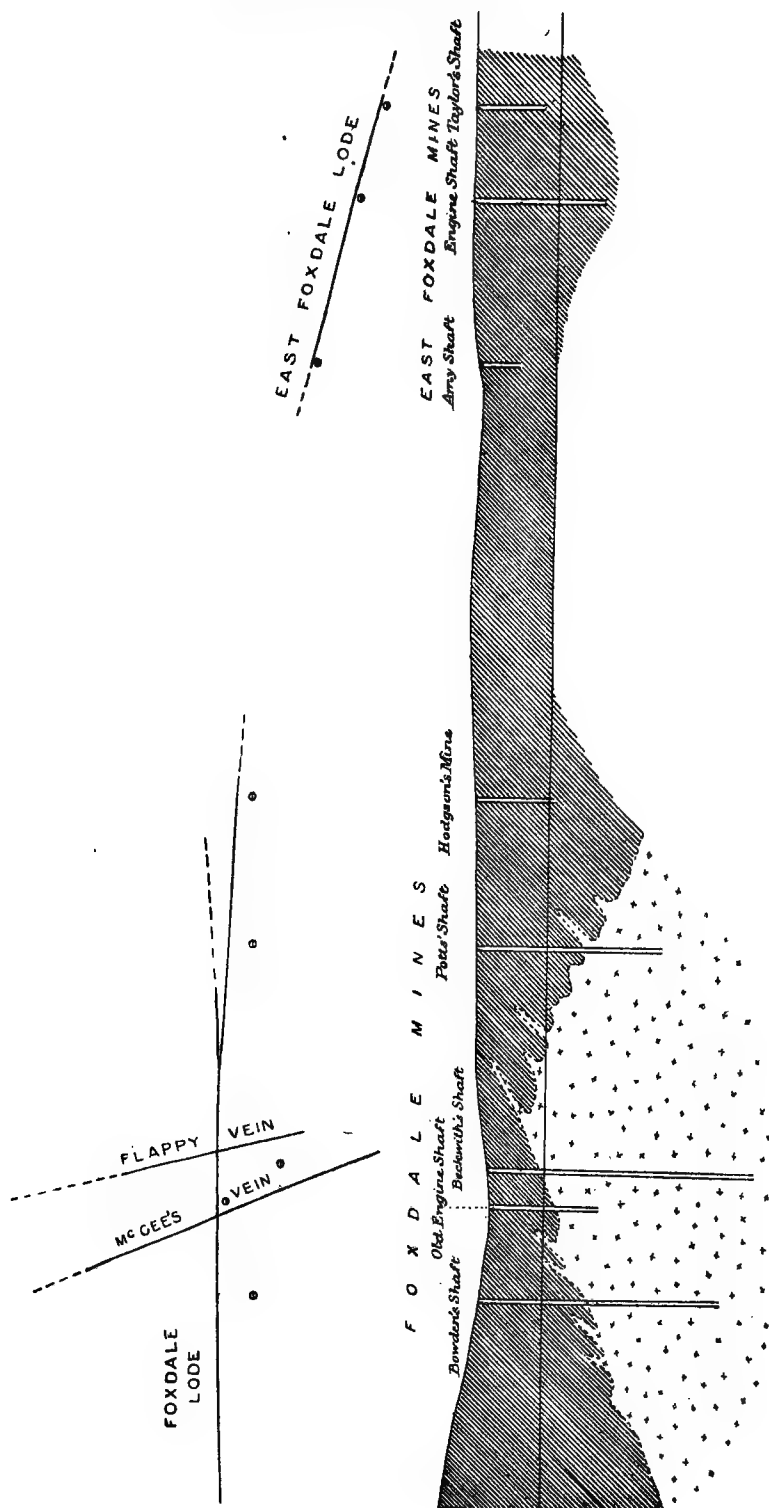
In the report for 1857 it is mentioned that down to below 90 fathoms the mine had been marvellously rich, but that the lower levels, at 117, 132, and 147 fathoms, had been driven on a lode showing hardly any trace of ore; and that a great drawback was found in the enormous amount of timber required and its rapid destruction by dry rot as well as by the heavy pressure of the strata. The N. and S. cross-vein had been opened to 160 fathoms S. of the shaft in the 75 fathom level, and a course of ore got in the same vein in the 60 fathom level N. In 1858 reference is made to a trial known as WEST BECKWITH'S at the western part of the Foxdale sett, where a shaft had been sunk 13 fathoms on a large lode filled with black clay-slate, but without ore. In 1859 it is noted that in the principal mine the total poverty of the lower levels had been a little relieved by

FIG. 110. *Diagrammatic plan and section of the Foxdale Lode.*

Manx Slates shown by oblique shading; Foxdale Granite and elvans by small crosses.

PLAN & SECTION OF THE FOXDALE LODGE.





some small sprigs of galena at the 132 level in the west cross-cut, and that the 117 level had some very good ore on the N. part of the lode. On the "Wardell's" cross-course the 75 level was out 200 fathoms S., while the 60 and 75 N., both poor at the end, had passed through "a long run of tolerably good ground which will yield material for stoping." At West Beckwith's a level had been driven E. for 50 fathoms "in black shale with a little quartz," and doubt was expressed whether it was in the lode at all. In 1862 it is stated that "great lengths of gallery have been opened beneath the formerly rich parts of the lode without finding any noticeable ore"; and detailed accounts of the 117, 132 and 145 fathom levels are given, showing a total length of unproductive driving of "about 317 fathoms." The reports for the ensuing years record the gradual cessation of all work except that of driving the adit eastward, according to covenant, to connect with Cross's Mine, 1,200 yards E. of Beckwith's. In 1877 the inspection of this adit is described; it was reached by descending the main shaft to 40 fathoms. and followed for 345 fathoms, to the end, which was in very confused ground "where the two lodes, the main one and the North Gill are closing together"; it was now within 50 fathoms of the old workings at Cross's Mine, and was barren of ore, nor was any seen in the numerous cross-cuts. This level is also referred to in the two following years, after which the mine is not again mentioned.

Cross's Mine.

This mine, the position of which has just been indicated, lies at an elevation of above 830 feet above O.D. This is evidently the 'Cronck Vane mine' described by Cumming in the passage above quoted (p. 501). Its history appears to have been a repetition of that of Beckwith's Mine on a smaller scale—a good but limited ore-body having been met with in the upper workings; and poverty below. It does not seem to have been worked since its abandonment at the date noted by Cumming. The mine consisted of two shafts 80 yards apart, viz., 'Engine Shaft' on the west and 'Whim Shaft' on the east; with levels at 20, 30, 40, 50, 65 and 80 fathoms. The ore-body described by Cumming lay mainly between the two shafts, and was lost below the 65 fathom level, and also in the drivings east and west of the mine. The longest or pioneer levels were the 80 fathoms, which went 79 fathoms west from 'Engine Shaft,' and the 50 fathoms, which was driven 95 fathoms east of 'Whim Shaft' and ended in barren ground about 50 fathoms short of the most westerly driving from Dixon's Mine.¹

Dixon's Mine.

This mine, lying to the east of Cross's at a distance of only 400 or 500 yards, was worked by two shafts 280 yards apart, with levels at 17, 32, and 47 fathoms in the 'Engine (western) Shaft,' and at 17 fathoms in the 'East Shaft.'² The day-level was reached by a cross-cut from the little valley north of the mine. As in the mine last described, the workings were wholly in slate; very little ore appears to have been found. Smyth mentions it in his report for 1857 as having been sunk to the 47 fathom level, but with nothing of promise in sight; and in the following year describes it as a "great disappointment," some productive ribs at the 17 fathom level having gone out in the 32, and on the south side there was similar deterioration below the adit level. In 1865 we learn on the same authority that after being for many years abandoned a shaft and adit were reopened. In 1867 the adit had been cleared for no less than 200 fathoms, and the 17 fathom level opened, with a little lead westward, but on the east for scores of fathoms without showing a speck of ore; from the 34 fathom level a cross-cut had been driven out

¹ Information from mining plans in the office of the Foxdale Company.

² *Ibid.*

in which it was difficult to recognise the limits of the lode ; and only a few tons of ore in all had been raised from this new undertaking. In 1868 it is noted that only a cross-cut at the 44 level was driving ; and this is the last mention of the mine in the reports.

Foxdale (Old Foxdale) and associated Mines.¹

In following the lode eastward from Dixon's we descend into the Foxdale valley by a steep slope on which there have been a few shallow unproductive trials in the slates. The Foxdale Mines, from which by far the greater proportion of the mineral produce of the lode has been obtained, lie at the foot of this slope at altitudes of between 400 and 450 feet above sea-level. The principal shafts now in operation are—Bawden's the most westerly, with the bottom level at 260 fathoms ; Beckwith's, with the bottom at 290 fathoms² ; and Potts, the most easterly, with the bottom at 200 fathoms. The distance in a straight line between the first and last-mentioned is 750 yards, and the extreme length of the underground workings from end to end in 1897, was 1,510 yards ; the pioneer level westward being the 170 fathoms, which went 320 fathoms west of Bawden's and approached within about 175 fathoms of the overhead position of the east shaft at Dixon's Mine ; and the pioneer east, the 127 level, going 435 fathoms east of Bawden's. The above-mentioned shafts are sunk vertically on the southern side of the outcrop of the lode, and intercept it on the underlie. They commence in slate, but pass, at varying depths, into granite, as shown in the section (Fig. 110, p. 507), their lower workings being entirely in the igneous rock.

In the higher part of the mine the slate is traversed by elvans springing from the granite, which render the shelving upper surface of the intrusion ragged and uneven, just as it is seen to be at its outcrop on the hill-top south of the mines. Unfortunately the old upper levels which traversed the junction of the intrusive rock with the slate are now mostly inaccessible, and it is only at a few points that the contact can be studied. A few details respecting them may be gleaned, however, from Smyth's reports, quoted in the context. The junction was seen by the writer in 1896, in a cross-cut in the 115 fathom level, at the eastern end of the mine, and there showed distinct evidence of faulting, the granite being separated from the slate by a 'dowky' slightly slickensided vein an inch or two wide ; but the vertical displacement did not appear to be great. As previously mentioned the lode, of which this vein seemed to form one of the 'branches,' is rarely a simple fissure but a belt of disturbed 'country,' with more or less parallel fractures showing nearly horizontal slickensides and containing brecciated rock, with vein-stuff and ore generally in ribs but occasionally also brecciated. The granite included in and adjacent to the lode has undergone partial decomposition, and it softens and 'bursts' on exposure to air in the workings ; while the same rock exposed in cross-cuts outside the lode remains solid and very little altered. The rock thus affected is rendered somewhat 'platy' by numerous joints parallel to the vein, some of which exhibit traces of movement ; and the miners appear to regard all material of this character as part of the 'lode,' ribs of ore being likely to occur anywhere within it. The 'bursting' of the rock-faces in the workings is probably due to the feldspars having been decomposed while under restraint, rapid expansion taking place as soon as relief is obtained.

The ore-bodies have a general trend downward towards the west. The chief minerals associated with the galena in the vein-stuff have been enumerated in the passages already quoted. The western portion of the

¹ Our thanks are due to Capt. W. H. Kitto and Capt. Lean for their courtesy in affording us facilities for studying the plans and underground workings of these mines and the plans of several abandoned mines in the neighbourhood ; and to Capt. J. Kitto, sen., for information in respect to many of the older workings in this and other parts of the Island.

² Beckwith's Shaft has now a level at 305 fathoms, and is being sunk for a 320-fathom level. (August, 1902.)

mines is on the whole characterised by the presence of large bodies of coarsely crystalline galena poor in silver; and the eastern, by smaller quantities of fine-grained ore rich in silver. With regard to the occasional presence of the rarer minerals, *silberfablerz* and *plumosite*, we learn from Sir W. W. Smyth's and Capt. Kitto's notes that these minerals are limited to that part of the vein which lies in the vicinity of the junction of the slate with the granite.

The seam of "indurated black clay" mentioned by Sir W. W. Smyth as a peculiar feature of the lode is rarely absent, serving the miners as an indicator where the vein is pinched or unproductive. It varies from a mere film to a thickness of 2 or 3 inches, and widens out into a 'dowky' mass in the vicinity of the ore-bodies; and in such places is reported sometimes itself to contain 'stones' of ore. It has probably been brought down by percolating waters from the overlying slate during one of the later expansion-movements along the fissure, perhaps at the same time as the detritus observed by Smyth in the 170-fathom level east, which exhibited "the peculiarity of fragments of killas or clay-slate in the breccia [of the lode], unexpected so deep in the granite." (MSS. Report for 1894. See also description of the 155-fathom level quoted in the context.)

Between Beckwith's and Pott's shafts the lode in going eastward splits into two branches, and to the eastward of the Pott's shaft becomes obscure and difficult to follow. The abandoned workings farther eastward will subsequently be described.

Regarding the cross-veins known as *MAGEE'S VEIN* and *FLAPPY VEIN*, which, as shown in Fig. 110, are about 140 yards apart and strike across the main Foxdale lode in the neighbourhood of Beckwith's shaft, little information is now procurable, as the places where they intersect the main vein in the upper levels are inaccessible, while in the lower levels they are not definitely recognisable. We may suppose that, like Wardell's North Lode at Beckwith's Mine (p. 505), they were formed at an earlier date than the E.—W. main vein, as otherwise some indication of displacement of the latter at the intersection would probably have been noticed. Both have yielded lead-ore in limited quantities. *FLAPPY*, the more easterly of the two and the one referred to by Berger (p. 500), is shown on the mining plans as having a course of S. 22 deg. E., with a westerly dip. It was followed for 150 fathoms southward in a driving from the 20-fathom level E. of Old Engine Shaft of Foxdale Mines, and had also three levels, viz., adit, 20 and 30 fathoms; from a shaft on the lode; and was further tested by workings 650 yards north of Foxdale. *MAGEE'S* strikes S. 30 deg. E., with a westerly dip, and therefore converges towards Flappy, with which it is supposed by the miners to unite on the hillside south of Foxdale. It is no doubt the "strong vein" west of "Engine Shaft" shown on Twigg's plan of 1826 (p. 500). It was worked on a small scale as recently as 1878, by a shaft 300 yards S. of Foxdale, as described by Smyth in the reports quoted below. The vein is supposed to be visible at the surface, in the slate-quarry at the margin of the granite mentioned in a previous chapter (p. 165).

The following information illustrating the geology of the main lode in the older parts of the Foxdale Mines is abstracted from the annual MSS. reports of Sir W. W. Smyth, whose interest in this mine was always keen. In his report for 1857, we learn respecting "Old Foxdale" that in the 50 fathom level a part of the lode adjoining a dyke of granite was unusually rich in silver (up to 300 oz. per ton of lead) and that to the west of the [Old Engine] shaft large quantities of sparry iron-ore formed the bulk of the lode. In 1860, the Engine Shaft is stated to be about 4 fathoms below the 86 fathoms, in a very hard close-grained granite, and the lode brecciated on a large scale, but exhibiting no lead ore; while in the 72 level west there was an excellent lode, "the ore parts yielding silver in very variable proportions, but averaging 70 oz. to the ton of lead." In 1861, the last-mentioned level is described, in which "a cross-cut south near the end has entered a white granitic porphyry, and found a small south vein separating the latter from clay-slate;" and in the shaft, now at 96 fathoms, "all except the south side is in very hard granite; on that side a large amount of sparry carbonate of

iron is visible, which I hope promises for the continued strength of the lode in descending." In the 72 fathom level east, some of the galena ran to the extent of 180 ounces per ton in silver. In 1862, the east and west driving of three levels—the 86, 72, and 60 fathoms—is described, "now against granite, and presently against slate"—"varying much in richness, but on the whole offering to view a noble lode of highly argentiferous lead ore." In 1865, the deepest level was the 100 fathom, which was 105 fathoms west from Engine Shaft in a fine lode 5 feet wide, between soft granite walls, and rich for lead ore, but was impoverished east of the shaft. In 1866, when the deepest level was still the 100 fathom, the report contains the following passage [regarding which we may note that the later workings have fully justified Smyth's judgment and confidence]:—"It becomes now an interesting question whether the vein will be as productive when entirely in the granite as when passing between alternations of that rock and slate. I myself see no *a priori* reason to doubt that it will be as good, and hence look forward with impatience to the driving of a deeper level." In 1867 we learn that the bottom or 115 fathom level west, all in granite, had a rib 2 to 8 inches wide of good lead ore, but not rich in silver; while specks and lumps of fahl-ore or tetrahedrite very rich in silver had been found in stopes on the 100 fathom east. [This concentration of the ores rich in silver in the northern side of the vein near the junction of the granite and slate deserves especial attention.] In 1868, it is noted that "this is the second year during which considerable quantities, amounting to 8 or 10 cwt. (in the rough) of highly argentiferous fahlerz have been raised from the mine." In 1872, the 72 fathom level west under the mountain [the pioneer level at that time] is described, in which a cross-cut north for 20 fathoms near the end was in hard white granite. The 115 fathom west showed in one place "ore of a gossany character with spiculæ of cerussite or white lead ore, rather a rare feature at such a depth." Bawden's Shaft, now 10 fathoms below the 127 fathom level, was sinking in hard granite, "the rock exceedingly obdurate, but showing a small vein of hard breccia with some steel-grained lead-ore." The 100 fathom level east was out 205 fathoms from "Old Shaft," and the lode in the end "full of clay slate." In 1873, it is mentioned in regard to the end of the 86 fathom level east that "here, too, the walls change again to soft clay slate." In 1880 "the 140 fathom has for a very long way been entirely sterile—large and conglomeratic in the end, with embedded stones of dark granite"; and the west ends of the 170, 155, and 140, all somewhat alike, show "a great lode of disintegrated white granite seamed by small veins of black indurated clay, and showing only specks of lead and zinc ore with a little quartz and traces of fluor." In 1881, the 84 fathom level east is described as containing "the finest regular rib of ore ground which I have seen in the mine, the lode very uniform and averaging 20 to 24 inches wide of very compact galena of medium richness and silver." In 1882, Beckwith's Shaft had been sunk 40 fathoms "in rather hard schist." In 1883, the 127 E. at 190 fathoms from Old Shaft had a lode 3 feet wide, "with a copper-bearing branch [unusual in this mine], and strings of dark quartz containing steel-grained ore, and a little of the silvery fahl-ore." The adit driven westward to prove the ground under the mountain was over 150 fathoms long, in 'dout' or argillaceous vein-stuff but uniformly poor. In 1885, it is noted that all the workings at less than 100 fathoms were stopped; the 140 E. showed a good deal of white barytes and chalybite, with several strings 6 to 10 inches apart of good silvery ore; the 200 W. had laid open "a magnificent lode of ordinary galena," "reminding the observer of the richest of the Spanish mines"; and surprise is expressed that the new shaft though in solid granite had required timber for half its length. In 1886, when some of the eastward deep drivings were getting out of the granite, we learn that the 127 level showed bunches and strings of dark ore, richer than the average in silver, and "very much like Mexican and Hungarian ores"; in the 140, E. end, there was "schistose rock on both sides, taking the place of granite"; the 170, cross-cut S. close to end, "again revealed a wide body of schistose rock of white hue, which towards

the end lay almost flat upon granite" [possibly a highly sheared aplite dyke, see p. 165]; while the 185 level had granite for the 'country' on both sides. In 1887, the 155 level E. "presented the curious feature of contorted blue shiny slate, forming the body of the lode against a granite foot-wall, but without ore"; the 215 E. of Bawden's Shaft had "a marvellous lode" 6 to 9 feet wide, capable in places of yielding 8 to 10 tons ore per fathom. The last of these reports is for the year 1888. It states that the deepest level was the 230 fathom; that the 170 E., in soft killas or slate rock, had a cross-cut a little way back from the end, driven N. for 4 fathoms in granite, sometimes very pink; and that in the 127 E. on the N. branch of the vein, here a curious jumble of pyrites, lead ore and chalybite, a parallel vein with highly argentiferous fine-grained steel ore had been found by cutting 4 fathoms still further N. through slaty rock.

TABLE SHOWING ANNUAL OUTPUT OF SILVER-LEAD ORE FROM THE
FOXDALE MINES BETWEEN 1845 AND 1900.

From Mineral Statistics in Mem. Geol. Survey, vol. ii. (for 1845 and 1847); Records of the School of Mines, vol. i., pt. 4 (for 1848 to 1852); Home Office, Mineral Statistics (1853 to 1900).

Year.	Lead-ore.	Silver contained in Lead-ore.	Estimated Value.	Year.	Lead-ore.	Silver contained in Lead-ore.	Estimated Value.
	Tons.	Ounces.	£		Tons.	Ounces.	£
1845	1,902	No data.	Value of Lead-ore not stated before 1874.	1873	1,433	57,727	—
1846	2,071	"		1874	1,673	67,868	31,562
1847	2,040	"		1875	1,722	73,564	37,804
1848	1,566	"		1876	1,607	65,183	33,284
1849	1,527	"		1877	1,727	87,700	32,314
1850	1,340	"		1878	1,959	53,453	29,753
1851	1,660	"		1879	2,766	55,319	37,363
1852	1,600	12,224		1880	3,486	49,799	42,993
1853	1,750	18,800		1881	3,419	69,080	39,145
1854	1,900	19,926		1882	3,211	48,807	36,356
1855	2,535	26,756		1883	3,700	48,100	35,100
1856	2,500	35,512		1884	4,020	51,525	33,500
1857	2,125	30,136		1885	4,670	59,851	42,400
1858	1,820	25,807		1886	4,013	51,435	43,000
1859	1,650	37,028		1887	4,322	55,396	41,500
1860	1,950	43,144		1888	4,009	59,397	44,600
1861	2,082	56,098		1889	4,185	62,010	44,400
1862	1,739	53,900		1890	4,160	61,640	44,500
1863	1,715	54,480		1891	4,700	69,641	45,200
1864	1,792	65,173		1892	4,650	73,550	40,250
1865	1,590	57,236		1893	4,650	73,550	35,400
1866	1,615	65,808		1894	4,800	85,522	34,430
1867	1,579	70,675		1895	4,600	00,359	39,200
1868	1,774	72,427		1896	4,250	188,473	36,700
1869	1,700	69,959		1897	3,775	76,697	34,100
1870	1,800	81,880		1898	3,610	66,125	34,000
1871	1,670	75,032		1899	3,610	62,515	39,800
1872	1,734	86,050		1900	3,610	58,905	43,100

Respecting MAGEE'S MINE, Smyth notes in 1859 that it was "on a north and south lode, in which a winze is sinking below the 40 fathom level. The veins are here in the midst of solid granite—mere strings, and but little ore

is raising from them." The mine is not mentioned again until 1868, when it had three ends advancing, and was yielding some 10 to 13 tons of ore per month. In 1871, we learn that the 60 fathom level was driving south, and the 72 both north and south, and the shaft was being deepened; the lode, generally only a few inches wide and encased in very hard granite, had opened to 5 feet wide in one part below the 60, and also proved continuous beyond a dislocating cross-course. [The last-mentioned fact apparently furnishes another example of the displacement of N.-S. lodes by E.-W. faults, and lends strength to the supposition advanced above as to the relations of this vein to the main Foxdale lode.] In 1873 the mine had been deepened to 84 fathoms, but the vein was still the same small string, and work was soon afterwards abandoned.

Hodgson's, otherwise Faragher's or Louisa Mine.

This mine, the latest working of which took place over twenty-five years ago, lies immediately to the eastward of the present Foxdale Mines. The principal (Louisa) shaft is 260 yards east of Pott's Shaft, and one or two of the higher levels are connected with the corresponding levels of that mine, the two shafts having at one time been worked together, under the name of Faragher's Mine, on the south branch of the Foxdale lode. The Louisa shaft was sunk to a depth of 82 fathoms, with levels at 10, 20, 38, 53, 67, and 82 fathoms, the pioneer eastward being the 20 fathom which was carried 110 fathoms east of the shaft. Two small pits, respectively 50 and 90 yards east of this shaft, descended only into the upper level of the mine.¹ None of these workings reached the granite, slate being the country-rock throughout the mine. A fair quantity of ore was obtained at an early period in its history, but the subsequent operations were unprofitable.

Sir W. W. Smyth's reports contain a few references to the latest working, from which the following details are taken. It was in operation in 1860 and 1861, but yielded no return. In 1863 Smyth notes that the 52 fathom level was driving east and west on a greatly improved lode, with an excellent rib of lead-ore. In 1865, the 67 fathom level had been opened east and west, with only an unsatisfactory quantity of ore. In 1870, the 67 and 82 fathom levels were equally poor at ends, but there were "stopes with a little good ore in the midst of soft killas rock." The latest reference to the mine is in 1874, when the 30 fathom east, having been cleared, showed a little ore here and there, but nothing regular; and in the 72 and 84 levels the vein was "too small."

To the eastward of this mine there is a belt of crushed sericitic slate, occupying the ground up to the depression half a mile distant in which the Santon River has its source. Numerous shallow trials have been made without success in this tract to find the prolongation of the lode. As suggested in a previous chapter (p. 166), there may possibly be extensive transverse faulting in this hollow, perhaps the continuation of the eastern boundary fault of the Peel Sandstone; and this may explain the isolation of the small outlier of granite $\frac{1}{2}$ mile south of Eairy (p. 166) and the shattered condition of the slates between this outlier and the main granite mass, a condition likely to render the ground unfavourable for the production of lode-fissures. At the hamlet of Eairy, immediately to the eastward of the hollow, however, some extensive mining work, known as the East Foxdale or Central Foxdale Mines, has been done on a vein supposed to represent the continuation of the south branch of the Foxdale lode. The identification is scarcely convincing, since the Eairy vein differs in many of its mineral characters, and in its more southerly strike, from any portion of the Foxdale lode above-described.

¹ Details from plans in Foxdale Co.'s Office.

East Foxdale, otherwise Central Foxdale Mines.

The East Foxdale workings comprise the Amy Shaft a few yards east of the bridge at Eairy; the Elizabeth, afterwards renamed Engine, Shaft, 350 yards farther eastward; and Taylor's Shaft, 200 yards east of the last. The first-mentioned appears to have been only once in operation since the early days of the mine (see Smyth's report for 1876 quoted below), and according to plans preserved in the Woods and Forests Office had only a depth of a little over 40 fathoms, with short drivings at 10, 30, and 40 fathoms. The other shafts have been reworked two or three times, after longer or shorter intervals of inactivity, the last working continuing up to 1889; by which time Engine Shaft had attained a depth of 145 fathoms, and Taylor's Shaft 74 fathoms, with levels at about every 10 fathoms down to 40 fathoms, and every 15 fathoms below. Although in the aggregate a considerable quantity of lead-ore averaging well in silver (about 35 oz. per ton) was obtained from the mine (see Table p. 515) it was insufficient to pay working expenses. The chief ore-bodies were found to the east of Engine Shaft. The ground was complicated and difficult, two or three separate lodes or branches of the same lode being recognised. Geologically the most interesting feature of the mine is the occurrence of an intrusive dyke of olivine-dolerite (supposed to be of Tertiary age, see p. 327) in association with the lode. Similar dykes occur in connection with north and south metalliferous veins at Ballacorkish, Bradda, Glen Auldyn and other places in the Island, as elsewhere described, but this is the only known instance in the Foxdale district, or in any other lode with an approximately east and west course. The significant bearing of this matter on the origin and age of the metalliferous infilling of the veins has been discussed in the introductory part of the present chapter. The mine-workings are now inaccessible, and the information which I was able to collect on the spot regarding the mode of the occurrence of the dyke was meagre and unsatisfactory; but fortunately Sir W. W. Smyth's reports, quoted below, contain many valuable details on this point and prove that the lode in this portion of its course is newer than the intrusion. There is a doubtful exposure of the dyke at surface on the steep slope immediately E. of the bridge at Eairy (see p. 169); in the spoil-heaps of the old mine 400 yards farther east the rock is present in abundance.

The mine was reopened, under the name of "East Foxdale," between 1860 and 1863, but beyond the statement that £11,000 were then expended without result, Smyth's reports contain no details of this working. In 1871 a new company commenced operations, and in Smyth's report for 1872 we read— "The old workings of the 30-fathom level and the newer ones of the 60 and 75 fathom levels show a great deviation from the regular course of the Foxdale Lode, and the presence of dykes and masses of a trap rock" rendered the mine a costly problem. In the following year a 15-fathom cross-cut from the 90 level showed "more or less confused appearance of vein-stuff," and in Taylor's shaft driving was going on "in the middle lode of three which had been tested. In 1875 the name of the mine had been changed to "Central Foxdale," and the report states that the Engine Shaft was sinking below 90 fathoms (in killas, and the 90 level had been driven "east about 40 fathoms from the shaft and, from the place where the lode was cut, is amid the black trap rock, in which mere strings of spar without any ore are seen. Where the grey killas or slate comes in again the lode improves, and a few stones of ore have been met with"; the 90 west was out 15 fathoms, in ground much disordered and not promising; "the 60 east has been driven east beyond the confusion caused by the trap, and looks for the last fathom or two as if in a wide body-mass with small occasional spots of lead ore, exhibiting as its most promising feature ribs of chalybite or spathose iron-ore." In 1876 Smyth notes that he descended to the 40 fathom level in Amy's Shaft "to see the driving west which has the black trap rock alongside the vein on the north, and altogether a very unpromising appearance." In 1877 the various drivings are described,

including the 90 east, in which an exceptional body of rich ore ground had been found; and the difficulty of becoming acquainted with "the ramifications of these disordered lodes" is commented on. In 1878 the "hard black stone" is mentioned as making its appearance in the 105 level west.

Up to this time Smyth seems to have entertained the miners' opinion that the dyke cut out the lode, and his report for 1880 is therefore especially important in showing that he found this opinion no longer tenable. The passage in question reads:—"At the 120, the deepest level, a careful examination shows that the 'black stone' or *dolerite* which it was feared might cut off the lode, is really intersected by it, and in the eastern drivings the lode, divided into two parts, exhibits a considerable improvement." [Italics not in original.] Similarly, in his report for 1882 he mentions that in the deeper level then driving, at 135 fathoms, where the lode was in places very wide, between walls of clay-slate, there had been "a somewhat alarming appearance" of *dolerite*, but that it "seems really not to have injured the lode." In the previous year he noticed that in the 105 level east, where the lode had split into two branches, the north branch had got into "the volcanic rock of a rather pale tint."

In 1883 the mine was again standing, but was resumed by a new company in the following year. In 1886 the report states that 25 to 30 tons of ore per month were being raised, and that the 145-fathom level (the deepest point attained in the mine), driving east on the south lode, had met with some 'greenstone' on the north wall. In 1888, in the last of his reports, Smyth mentions that he did not go below, but gives the information that "spots of copper, with lead and zinc" had been found in a driving at 135 fathoms on the south lode; and adds that "some stones of granite which have appeared in the bottom level form a reminder of the bottom levels of Old Foxdale and give encouragement to further sinking." Under the circumstances it may be doubted whether the "granite" referred to was anything more than one of the granitic elvans by which the slates in the vicinity of the mine are traversed (p. 167); at any rate no confirmatory evidence has been obtained for the presence of massive granite in the mine.

Output of Lead-ore from East or Central Foxdale Mine (from "Mineral Statistics").

Year.	Lead-ore.	Silver.	Year.	Lead-ore.	Silver.
	Tons.	Ounces.		Tons.	Ounces.
1872	50	819	1881	400	5,362
1873	135	2,200	1882	450	10,440
1874	58	968	1883	530	15,900
1875	20	280	1884	330	9,839
1876	70.	591	1885	325	6,447
1877	198	1,184	1886	319	10,149
1878	360	6,074	1887	418	11,625
1879	360	4,337	1888	250	6,953
1880	250	5,032	1889	92	2,559

From the above descriptions it is evident that even if the Foxdale Lode be prolonged in these mines it has lost its definiteness of character and direction; and it is therefore not surprising to find that all efforts to follow it still farther to the eastward have, up to the present, proved ineffectual. Traces of these old trials break the surface in several places on the Dreem Lang ridge east of Eairy, while in the valley near GARTH, one mile east of the EAST FOXDALE mines, a more extensive trial known as the NEW FOXDALE MINE was made in 1884-7 with no success.

The prospectus of this trial stated that the vein to be tested was 18 ft. wide and contained carbonate of iron, barytes, quartz, pyrites, galena and blende. The principal working consisted of a cross-cut adit on the right bank of the stream, driven about 30 fathoms to the lode; with a level from it for 30 fathoms westward on the lode; and three short cross-cuts south from the level; only "indications" of ore were obtained. The sericitic slate which forms the 'country' in this locality is traversed by an elvan of microgranite, which was cut in one of the workings (see p. 168).

Ellerslie, otherwise known as Bishops Barony, Great East Foxdale, or Darragh Mine.

This old mine is situated on the Bishops Barony on the south-western side of the central valley of the Island, $\frac{1}{2}$ mile S. of Crosby, at the mouth of a little glen of the stream draining from Garthi. It has been worked on an E. and W. vein supposed to be connected with the Foxdale lode. The mine has been reopened at various times, but always without commercial success, and is now in ruins. From Mr. A. W. Moore's researches it appears that the mine was commenced about 1825 by the orders of Bishop Murray, the site being fixed "by following the direction of that rich vein which had been wrought to such great advantage at 'Little Foxdale'" (quoted from the "Manx Advertiser" newspaper). Cumming, in 1848, gave the following account¹:—"It appears to have been commenced on a very thin even vein, consisting of a narrow thread of ore in veinstone, the outcrop being visible at the surface in a small burn The vein which has been pursued from its outcrop upwards of 300 fathoms, at a depth of 6 to 10 fathoms presents such a striking uniformity as greatly to discourage further working. At one or two points cross-courses have been met with, but they do not affect the value of the vein."

By the later workings a shaft was carried down to 75 fathoms, and a small quantity of lead obtained. In 1875 the mine, then recently reopened, was examined and reported on by Smyth, who described the principal level as 75 fathoms deep, "and in this a lode varying generally from $1\frac{1}{2}$ to 3 feet in width opened occasionally, as in the present end E., to 5 feet, yielding promising ribs of ore."² In this report Smyth inclined to the opinion that the lode, from its "line of bearing and the character of the ores," might represent the prolongation of that of Foxdale; but in a later report (for 1885) he concluded that the mine was tolerably certain to be on a different lode from Foxdale. In 1878 he noted that some fine quality of ore was being obtained from pitches in the back of the 70 fathom level.

In "Mineral Statistics," returns of lead-ore are given from "Great East Foxdale Mine" in 1875 and the three succeeding years, amounting in the aggregate to 301 tons, and 8 tons in 1883 from "Glen Darragh Mine."

Cornelly or Townsend Mine.

This mine, abandoned since 1884, was worked on an east and west lode parallel with that of Foxdale, about a mile farther north, on the northern slope of Archallagan, at the head of a short deep glen—"Glen Darragh" of the 6-inch Ordnance map (Sheet 9), but now known to the country folk as Ballacurry Glen. The lode was of a curiously irregular character, and not easy to follow. Cumming mentions the mine as in operation in 1845-6; but respecting these early workings, when it was known as the "Cornelly Mine," no detailed information has been obtained; the later operations under the title of the "Townsend Mine," between 1874 and 1884, are described in Sir W. W. Smyth's reports (see below); and plans are also

¹ "Isle of Man," p. 310.

² MSS. in Woods and Forests Office.

preserved in the Woods and Forests Office and in the office of the Isle of Man Mining Company at Foxdale. From these plans it appears that at the cessation of the last workings, the mine consisted of two shafts 12 fathoms apart, with levels from the Engine Shaft (the deepest) at 20, 40, 50, 65, 80, 95, 110, 125, and 140 fathoms. The pioneer level was the 95 fathom, which was carried 360 yards east and 195 yards west of the shaft, with a cross-cut going 70 yards southward from it. The chief ore-bodies were found in the neighbourhood of the shafts. The lode was very steep, with a slight underlie southward in the upper 80 fathoms and in the opposite direction below that depth. It contained much chalcidony, and had been affected to even a greater degree than the Foxdale lode by recurring movements by which the vein-material as well as the country-rock had in places been fractured, rounded and afterwards re-cemented. Among the minerals noted by Sir W. W. Smyth² from this vein besides galena, chalybite, etc., are semi-opal or cacholong, hornblende. ("mountain-leather"), a beautiful iridescent variety of galena, and a curious variety of zinc-blende in balls with a radiated structure. A considerable output of lead-ore was made from the mine, but not in quantity to pay the expense of working. As the returns were included with those of the Foxdale Mines, no statistics are available.

The chief geological interest of the mine lies in the fact that, as mentioned on p. 165, though nearly 1½ miles N. of the nearest outcrop of the granite, the shaft penetrated that rock beneath the slate at 300 to 400 feet below the surface. Judging from the material on the spoil-heaps, some part of the igneous rock reached in the mine possessed the massive boldly-crystalline character of the Foxdale intrusion, and was not like the micro-granite dykes which strike out from that mass. It is therefore probable that the granite represents a local protuberance on a deep-seated mass, and not merely a dyke. The rock seems to have occurred very irregularly in the workings, at first in detached strings and afterwards in a massive body; and the deeper levels both east and west were again in slate, though the cross-cut south was in granite. The evidence given below suggests that the intrusion formed a pipe-like mass inclining westward; the fine-grained material mentioned in the reports probably occurred around the margin, with the more coarsely crystalline rock described on p. 315 in the interior. The high degree of schistose and garnetiferous alteration in the slate-rock of this vicinity has been discussed in a previous chapter (pp. 111-2).

It is fortunate that Sir W. W. Smyth's reports contain descriptions of this interesting mine, as the workings are now inaccessible. The following passages have been selected from these reports as showing the general character of the lode and of the granitic intrusion.³ In his report for 1875 Smyth states:—"The shaft is again sinking [below the 60-fathom level] and a peculiar phenomenon which somewhat links this mine with Old Foxdale is that veins or tongues of granite intersect the schistose rock, whilst a great difference is in the hardness of the rock, which scarcely requires any timbering." In 1877 we learn that in the 80-fathom E. level (then the deepest) "the lode is generally 2 or 3 feet wide, but carrying narrow vugs or caverns of great length lined with beautiful crystals of galena, but not enough to make a rich lode." In 1878, "the last 6 fathoms of the shaft [above 95 fathoms ?] were in hard grey granite; the 95-fathom level had been driven about 30 fathoms, and was productive nearly all the way through; the lode a very singular one, vuggy, sometimes fragmentary with sharp angular country stone; the ore attached very generally in single or groups of cubical crystals to thin plates of quartzey veinstone with brown spar; and the better parts giving about a ton to the fathom. . . . About the place where the east end [of the 80-fathom level east] was in 1877, granite had come in on the country and continues to the present

¹ For access to the later plans and much other information my thanks are due to Capt. W. H. Kitto, of Foxdale.

² In "List of Manx Minerals," op. cit., pp. 143-147.

³ From MSS. in the Woods and Forests Office.

end [*i.e.*, for about 45 fathoms] where the lode is pinched to dimensions of 2 to 5 inches." It is also mentioned that a quantity of gas, probably carbon anhydride, had been given off for weeks together in this part of the mine, a feature likewise observed in the Foxdale lode in granite (see p. 503). In 1879 it is noted :— "the Townsend mine is proving to be a remarkable place, as having a distinct character from either of the other mines in the neighbourhood [*i.e.*, Foxdale and Central Foxdale], and as yielding a large amount of lead ore very little intermingled with vein-stuff or foreign substances. . . The 95-fathom level west shows a small but ore-rib of 3 or 4 inches in mica-schist. A pitch above this level is in a wonderful group of parallel ribs and cavernous hollows studded with crystals of galena of all sizes up to 6 inches across; the whole occupying 3 fathoms in width, and having to be heavily timbered." The 65-fathom level east was driving—"the country intersected being micaceous schist, which in a large part of the deeper exploration is replaced by a granitello or unusually fine-grained granite." In 1881 the 95-fathom level east (which had commenced in granite) was visited, and "at 150 fathoms from shaft I found that for a long distance the level had been in a dark hard schist with an utterly sterile lode. . . . The 110-fathom level west was in a granitoid rock, very hard, with scarcely a vestige of a lode." In 1883 it is noted that the shaft was down below 140 fathoms, and that the 125-fathom level east had a poor quartzose lode of 3 feet, and a good rib, 4 to 6 inches wide, of beautifully iridescent lead-ore, while in the same level west the lode was a mere string an inch wide set in hard granite rock. The latest mention of the mine is in the report for 1884, where we learn, respecting the deepest level,— "the 140-fathom level which is again in the slate-rock, exhibited at first, on the east, the old 'Townsend' type of a hollow broken lode and with bold crystallisation of lead ore," but afterwards changed for the worse. The deepest level appears from this account to have been altogether in slate, but we are informed by Captain Kitto that the shaft itself was in granite to the bottom, though the ends of all the pioneer levels were in slate.

Traces of old trials are seen on the north side of Cooillingill near Crosby, 1 mile to the east of the above mine; and others, $1\frac{1}{2}$ miles to the west of it, on the western slope of the lower part of Foxdale (see List, pp. 552-53.) These are said to have been on supposed prolongations of the Cornelly lode; no further information has been obtained in regard to them.

Trials South of Foxdale.

On the southern side of the watershed, south of Foxdale and South Barrule, traces of old mining trials are to be found in most of the little glens wherever any appearance of a vein is visible, and indeed sometimes where there seems to be nothing to have encouraged the search. Those in respect to which no special information is forthcoming are included in the List of Small Workings given on p. 553. In his report for 1858, Smyth mentions that the researches in progress on the south side of South Barrule were "very precarious," and that a small shaft had been sunk near Ballamoda farm-house where some surface-stones of ore had been found. Another of these trials was made between 1870 and 1874 on the left bank of the Santon River, 60 yards above Campbell Bridge near Ballanicholas (Sh. 13), rather over a mile south of the East Foxdale Mines. This was known as the BALLANICHOLAS MINE; it returned $3\frac{1}{2}$ tons lead-ore in 1872. It appears to have been worked at the junction of a granitic elvan with slate (see p. 167); the lode was supposed to have a N.N.W. strike, but seems to have been ill-defined. Smyth refers to the working in his report for 1871, stating that a discovery of ore of remarkably fine quality had enabled a large pile to be raised from 3 fms. of driving at the bottom of a 12 fm. shaft, but that it did not look like a lode. In 1873, he mentions that the shaft was being sunk below the 10-fathom level; and in the following year that work had been suspended with the loss of some hundreds of pounds.

LAXEY GROUP.

Laxey or Great Laxey Mines.

Standing in the first rank of British metalliferous mines, this great mine has been second only to Foxdale in the Island as a producer of lead-ore, while its output of zinc-blende for a long series of years surpassed that of any other in the kingdom, and indeed was sometimes greater than that of all the other British mines combined. At one period of its career the mine was also a producer of copper-ore, though not to a large extent. As the Statistics given on a subsequent page will show, it has, however, of late years shown progressive decline, its annual output lately averaging less than half that of its palmy days.

The mine is established on a north and south lode (average direction about N. 10° W.), having an easterly dip, the country rock being the Lonan Flags of the Manx Slate Series. Although worked to within a mile of the coast, the lode has never been identified in the cliff-section, and was probably first discovered in the bed of the stream. According to an authority quoted by Dr. Berger, it was "opened and wrought by a mining company of Cumberland, about the commencement of the last [18th] century."¹ Mr. A. W. Moore ("History," vol. ii., p. 965) gives reference to documentary evidence of its having been worked about 1782. Feltham, in 1798 ("Tour, etc.," p. 243), mentions a "new level" 160 yards long, a mile and a half up the glen, which he examined. Woods, writing in 1811, gave a full description of the workings, which consisted of two levels from the banks of the river, the upper level, 100 yards long, following a vein nearly 4 feet wide consisting of quartz, blende, galena and some green carbonate of copper, blende being the most abundant; a small quantity of phosphate and carbonate of lead was also noted, and the lead reported to contain as high as 180 ounces of silver to the ton; but where the copper ore occurred, the lead was in small quantity and of poor quality [a feature subsequently found to characterise the lode in its deeper portions also]; in the new level, $\frac{1}{4}$ mile lower down the river, which was 200 yards long in 1808, carbonate of copper and blende alone had been discovered; only three men were employed in the workings.² The vein was again described by Berger in 1814³ and by Macculloch in 1819;⁴ but both observers found the workings abandoned; the latter author mentions the presence of calcareous iron ore (chalybite) and the steel-grained variety of galena. A plan of the mine by J. A. Twigg dated 1826, preserved in the Woods and Forests Office, shows the "Old level" as "wrought out," and a shaft, 34 fathoms deep, communicating with the "New level to unwater the mine."

Work was resumed a few years later on a more extensive scale, with profitable results; so that Cumming in 1847 found the adit to be 400 fathoms long, and two shafts, with drivings, down to 130 fathoms below the adit, employing 300 men.⁵ Since that time the development of the mine has been carried on continuously, the details being published in the periodical reports of the managers which are reprinted in the Manx newspapers.⁶ The principal underground workings of the mine are in the lower part of Glen Agneash (*Glen Moor*: 6-inch, Sh. 8), where the three deep shafts are situated. At the time of my visit at the close of 1895, the most southerly, or Engine Shaft, had attained a depth of 247 fathoms; the next, or Welsh Shaft, 150 yards farther N., was down to 295 fathoms; and the third, or Dumbell's, 520 yards N. of the last, was 266 fathoms deep, all following the underlie of the vein. These shafts have levels at about every 10 fms. down to the bottom; the pioneer level S. was the

¹ Trans. Geol. Soc., vol. ii. (1814), p. 51.

² "Account, etc.," op. cit., pp. 18-20.

³ Trans. Geol. Soc., vol. ii. (1814), p. 51.

⁴ "Western Isles," vol. ii., p. 577.

⁵ "Isle of Man," p. 308.

⁶ Files of these newspapers may be consulted in the Douglas Free Library.

235, which went 203 yards S. of Engine Shaft; and the pioneer N., the 255, which at the above mentioned date went 604 fms N. of Dumbell's Shaft; the length of the deep galleries from end to end of the mine is therefore over $1\frac{1}{2}$ miles. Shallow shafts communicating with the upper workings exist both N. and S. of those above mentioned.

MINERALS OF THE LODE.—The 'lode' varies greatly in breadth and character within short distances, both horizontally and vertically, being sometimes as much as 25 feet in width ('at the 190 fathom level near the shaft,' *vide* Smyth's report for 1857), and sometimes "gradually dwindled to a mere string without a speck of ore, hardly to be recognised by the unpractised eye" (in 110 N.; *ibid.* report for 1870). It usually presents clean well-defined and slightly polished walls of slaty flags, between which the infilling vein-stuff consists chiefly of quartz (with a little chalcedony) in ribs parallel with the walls, and calcite, mixed with more or less slate-breccia and with the metalliferous deposits. Zinc-blende and galena which constitute the principal ores occur alternating with quartz in ribs, and similarly in globular incrustations around 'vughs' or cavities in the lode. The copper-pyrites was mainly obtained in the southern part of the mine (south of Engine Shaft), "especially associated with dolomite,"¹ and occurred in thin strings after the ores of the other metals had dwindled down to an insignificant quantity; both here and in some of the deep levels farther north it seems to have formed a scanty ragged fringe to the great bodies of blende and galena of the central part of the mine, and its incoming was therefore looked upon with disfavour as indicating the proximity of the limits of these ore-bodies. The galena is of good quality, averaging 40 oz. to the ton of silver. Among other crystalline constituents of the lode are iron-pyrites, chalybite, pyrrhotine (northern part of adit, *vide* Smyth's report for 1882), barytes ("rare in Laxey"²) dolomite ("in perfect rhombohedrons"³) and calcite. Sir W. W. Smyth also notes the following in the old workings, or in the upper part of the lode: melanterite, sulphate of copper, melaconite, pyromorphite ("near Dumbell's shaft"); and steatite ("a white variety, spotted with crystals of zinc-blende, abundant at the 100 fathom level,"⁴) and anthracite ("a 3-inch band on the east wall of Laxey lode, 100 fathom level, S. of Engine Shaft, very pyritous").⁴

ANTHRACITE.⁵—The occurrence of the last-mentioned mineral is of peculiar interest, but the available information respecting it is meagre, and I have not been able to ascertain whether it was a constituent of the lode as Smyth appears to suggest, or belonged to the adjacent 'country' slate-rock. Mr. J. [E.] Taylor in describing the slates in 1864 mentioned the anthracite as occurring in 'thin veins,' and implied that it was interbedded with the sedimentary strata; but whether his description was based on personal observation or on miner's information is uncertain.⁶ According to the recollection of Mr. Killip, the under-manager of the mine, the substance occurred as a vein, not more than an inch thick and a few inches long, in the "copper ground" between the "Engine" and "Corner" shafts, and formed part of the lode on the hanging or east wall. Captain J. Kitto, however, who also had personal remembrance of the circumstances, thinks that the anthracite lay between beds of the country-rock and like them went off from the lode. The significance of this undecided point is that if interbedded with the slates the anthracite must be regarded as the product of contemporaneous organic growths, like the coal-seams of later times; but if a vein-deposit it would presumably be akin in its genesis to plumbago and other carbonaceous substances sometimes found in veins. It should be mentioned that no interbedded seam of this character was anywhere observed at the surface in the Manx Slate Series.

¹ "List of Manx Minerals." Trans. I. of Man Nat. Hist. and Antiq. Soc., vol. i., pp. 143-147.

² *Ibid.*

³ *Ibid.*

⁴ *Ibid.*

⁵ A specimen of this mineral from Laxey is preserved in the Museum of Practical Geology.

⁶ Trans. Manch. Geol. Soc., vol. iv., p. 75.

GRANITIC DYKES AND AGE OF LODGE.—The 'lode' appears to be a simple fissure-system extending down to an unknown depth, along which slight movement has taken place without causing much relative displacement of the opposite walls. As bearing upon its age it is interesting to find that in the northern part of the mine the lode breaks across the characteristic elvan-dykes of the Dhoon Granite. The nearest point of the surface-outcrop of this granite is on the hill-top, 1,050 yards east of the underground workings, and there is no indication in the bottom of the mine that the margin of the intrusion is any nearer than at the surface (p. 143). A dyke of micro-granite or quartz-porphry 20 feet in width, striking S. 20°-30° W., probably identical with that seen in the stream in Glen Agneash (p. 144), is traversed by the 255-fm. level (at this point about 1,800 feet below the surface) at 490 yards N. of Dumbell's Shaft; and the lode, carrying a little blende, distinctly cuts across the intrusion without perceptibly displacing it. A second, smaller elvan, 4 feet wide, is seen under similar circumstances 154 yards farther north in the same level. In the southern part of the mine the lode similarly intersects a group of the 'older greenstone' dykes, which were injected into the slates at a period anterior to the intrusion of the granite (see p. 144).

It has already been shown that the sedimentary rocks had undergone extreme deformation before any of these greenstones or microgranites were intruded among them; and moreover, that both sets of dykes have been affected by later movements of great severity. The development of the fissure has clearly been subsequent to the latest of these crushing movements, and cannot have taken place earlier than Carboniferous times, while it may have been much later; so that its metalliferous infilling cannot in any case have begun until towards the close of Palæozoic times, and is more probably long subsequent.

'SLIDES.'—Another factor of much consequence in relation to the age of the lode is that it is displaced at intervals by transverse (E.-W.) 'slides' or dislocations, which are apparently true normal faults. At the southern end of the mine, south of 'Corner Shaft,' the vein seems to have encountered a close-set group of these 'slides' and to have been dislocated and perhaps terminated by them, the various attempts to recover it in the lower part of the glen by day-levels and cross-cuts (including the 'Glyn adit' about 175 fathoms in length) having proved unsuccessful. Farther north the slides have better-defined individuality, the same dislocation being recognised by the miners in the successive levels down to the bottom of the mine. Thus the 'Big slide' intersects the lode at 160 yards south of Engine Shaft, and carries it 10 to 20 feet westward on the south side, the dislocation dipping south at about 70° from the horizontal and splitting into two branches below 30 fathoms. 'Welsh Slide,' emerging at the surface near Welsh Shaft, has a slightly steeper dip in the same direction and affects the lode in a similar manner, displacing it about 6 feet laterally (the chief "copper-ground" of the mine lying between these two slides); but according to the mining plans it unites near the 200 fathom level with another dislocation having in the opposite direction, known as 'Engine Slide,' the two enclosing a huge wedge of the lode between them. Farther north is 'Dumbell's Slide,' dipping south at 60°, and intercepted by Dumbell's Shaft at a depth of 12 fms.; and this is joined at 110 fms. by a slide with a slightly steeper dip in the same direction. In the explorations still farther north other dislocations were passed through, dipping in the opposite direction or northward, and consequently shifting the lode eastward on the south side; and these apparently form a rude northerly boundary to the ore-bearing ground. The average strike of these transverse faults is E 20°-30° N., which is also approximately that of the strata forming the 'country.' Wherever I was able to examine these faults in the mine-workings they presented a rather sharply cut joint-like aspect, generally with a little soft 'dowky' matter or crushed rock between the faces, but with no quartz. The direct vertical displacement which they have effected was estimated to range from 20 feet or less to about 70 feet, but this estimate is of uncertain value, as the movement has probably been oblique.

Though evidence was sought to show whether the deposition of the ore in the lode took place before or after its dislocation by these transverse faults, no very definite conclusion was attained. So far as I could learn, the only case of ore having been found in a slide was that reported to me by Captain W. H. Rowe, who remembered a little "steel-grained" galena being met with in the Agneash Slide between the adit and 12 fathom level. But this absence of ore may be due merely to the 'tightness' and lack of cavities in the fault-planes. The lode itself is usually impoverished in the immediate vicinity of the slides, consisting there chiefly of brecciated 'country rock' with very little quartz or metalliferous infilling; which suggests that it has been shattered by them before the formation of the ribs of quartz and ore within it. Hence, the indications do to some extent suggest a later date for the principal infilling of the lode; and it seems not improbable that the effect of the transverse faults may have been to reopen the older fissure and cause a slight gaping in it where the rocks were firmest and least liable to crumble, thus giving rise to empty spaces in which the crystalline constituents of the lode afterwards segregated. Unfortunately, owing to the absence of newer rocks than the Slates, the district affords no direct clue to the age of the faults; but it is worthy of note that on the Cumberland coast the N.E. to S.W. faulting has been shown to be Post-Carboniferous and Pre-Triassic (see p. 87).

While the metalliferous lode is for the most a single fissure, it is here and there complicated by minor 'branches' going off from it at a low angle, in which occasionally a little ore has been found; and other parallel but unproductive joints or fissures appear to traverse the slates in its vicinity, one of which, known to the miners as the 'East Lode,' has been reached by easterly cross-cuts about 70 yards E. of the main lode. The principal ore-deposits have been found in that part of the mine which lies between Engine and Dumbell's Shaft, occurring vertically in large irregular lenticular sheets showing a general tendency to descend northward. North of Dumbell's, the ore as yet discovered has been dispersed in smaller masses, with wider spaces of barren ground between, and in the most northerly drivings is reduced to mere specks.

THE 'COUNTRY-ROCK.'—In the principal part of the mine the strata belong to the Lonan Flags division of the Manx Slates and consist of firmly welded greyish and bluish sandy and slaty flags; and it is interesting to find that these extend without noticeable change of character from the surface to the bottom of the mine over 1,200 feet below sea-level (p. 33). Like most of the metalliferous veins of the Island, the lode is in the vicinity of the structural axis of the slate series; and the change in the direction of the dominant bedding, from S 20° E. to N. 20° W., may be observed in the mine-workings. South of Dumbell's Shaft the general dip of the contorted strata is at a high angle, usually between 60° and 80°, towards S. 20° E.; but in the 255-fathom level a short distance north of this shaft, the bedding ranges from vertical to 70° or 80° towards N. 20° W., and continues to dip in this direction, at a slightly lower angle, to the N. end of the level. In the deepest level (295 fathoms) the change sets in a little farther south, the N. 20° W. dip being found at about 450 yards north of Welsh Shaft. In both cases the obscure strain-slip cleavage is inclined in the same direction as the dip, but at a much lower angle, usually about 20°. The deep position of this structural anticline corresponds fairly well with its place at the surface. At about 700 yds. N. of Dumbell's Shaft the 255-fm. level passes into darker and more argillaceous strata for about 300 yds. and then into very hard sandy flags, which are probably the commencement of the Agneash Grits that outcrop on the mountain overhead; and as neither type of rock is so well fitted to develop an open fissure as the homogeneous flags farther south, it may be from this cause that the lode is pinched and impoverished in this part of its course. As the northward termination of the profitable part of the mine nearly coincides with the change in the direction of dip of the 'country,' the miners have come to regard this change as itself detrimental; but more probably it is because the N. 20° W. dip ushers in the unfavourable modification of the 'country' that it constitutes an untoward omen.

Precisely as the trials in Laxey Glen south of the mine, and on the coast, where an adit was driven 50 fms. into the cliff, have failed to discover the prolongation of the lode in that direction, so, also, trials have been made without success on the western bank of Glen Agneash, and again at the head of the glen (where it is known as Glion Ruy), to discover its northward extension. In this direction it would have approached nearer the outcrop of the Dhoon Granite than in any other part of its course; and the deterioration of the lode in the underground workings north of Dumbell's Shaft, as well as the poverty of the veins which have been tested at the Dhoon (p. 528) in close proximity to the igneous boss, tell strongly against the supposition that the presence of the metalliferous deposits is due to the contiguity of the granite (see also ante, pp. 491-2).

ANNUAL OUTPUT OF LEAD, ZINC, AND COPPER ORES FROM THE
GREAT LAXEY MINE BETWEEN 1845 AND 1900.

(From *Mineral Statistics in Mem. Geol. Survey, vol. ii.* (for 1845 to 1847) *Records of the School of Mines, vol. i., pt. 4* (1848 to 1852); *Home Office, Mineral Statistics* (1853 to 1900).)

Year.	Copper-ore. ¹	Zinc-Blende.	Lead-ore.	Silver contained in Lead-ore.	Total Estimated Value.
	Tons.	Tons.	Tons.	Ounces.	£
1845	79	—	327		
1846	92	—	220		
1847	60	—	375		
1848	—	—	695		
1849	—	—	815		
1850	—	—	810		
1851	—	—	900		
1852	—	—	800	32,400	
1853	—	—	698	28,130	
1854	64	1,435 ²	900	32,336	
1855	—	3,990 ²	800	24,400	
1856	94	3,000	700	24,675	
1857	169	2,909	500	17,625	
1858	403	2,777	600	21,068	
1859	354	—	800	19,826	
1860	333	3,181	800	16,936	
1861	731	3,255	600	11,184	
1862	942	691	700	16,380	
1863	1,263	2,298	800	19,440	
1864	127	5,356	1,250	59,000	
1865	1,317	5,488	1,500	65,293	
1866	294	4,960	1,800	81,054	
1867	400	5,362	2,100	93,365	
1868	412	3,278	2,300	105,020	
1869	400	7,208	2,200	101,244	
1870	300	4,067	2,130	87,760	
1871	100	5,718	2,300	98,221	
1872	300	2,973	1,300	52,316	
1873	—	5,370	2,355	94,870	

Value of lead-ore not stated before 1874.

¹ In *Mem. Geol. Survey, vol. ii.*, p. 715, the earlier statistics on next page are given respecting the annual sales of Laxey Copper-ore at Swansea. The output of the other ores for the same period is not recorded.

² Largest in the United Kingdom.

Year.	Copper-ore.	Zinc-Blende.	Lead-ore.	Silver contained in Lead-ore.	Total Estimated Value.
1874	—	6,925	2,100	86,268	£58,246
1875	—	11,753	2,400	107,420	90,915
1876	75	8,582	2,500	57,460	85,046 ¹
1877	8	8,645	2,222	94,749	77,835
1878	30	9,411	1,395	49,898	52,947
1879	—	7,200	1,200	40,500	46,792
1880	35	7,425	1,300	24,745	53,474
1881	—	7,568	1,700	52,50[0]	59,188
1882	—	7,750	1,755	70,200	19,950 ²
1883	200	4,720	1,540	61,600	45,176
1884	—	5,625	1,537	61,188	43,408
1885	236	5,340	1,588	63,219	42,700
1886	—	4,715	1,765	72,030	47,622
1887	—	4,540	1,545	63,052	42,207
1888	46	4,600	1,535	62,643	42,158
1889	—	3,900	1,615	65,908	43,880
1890	—	3,844	1,430	58,359	48,328
1891	—	2,825	1,120	45,708	32,763
1892	—	2,390	943	39,427	24,763
1893	—	2,145	902	36,811	18,701
1894	—	2,040	527	21,507	13,042
1895	—	1,417	403	16,447	8,917
1896	—	1,180	399	15,884	8,762
1897	—	1,610	247	10,080	8,894
1898	—	1,575	138	5,632	9,404
1899	—	1,390	158	6,448	11,831
1900	—	1,216	95	3,877	7,471

Appendix—SALES OF LAXEY COPPER-ORE AT SWANSEA, 1828-1837.

Year.	Tons.	Year.	Tons.
1828	28	1838	121
1829	161	1839	183
1830	238	1840	278
1831	283	1841	368
1832	341	1842	406
1833	249	1843	207
1834	268	1844	46
1835	77		
1836	89		
1837	69		
			Total 3,412

North LaxeY Mine.

The location of this mine is in the upper part of the Cornah valley, $1\frac{1}{2}$ miles west of Corran (six-inch, Sh. 8). It has been in operation, with short intervals of quiescence, since 1856, and has produced in the aggregate a considerable quantity of lead-ore, but not as yet sufficient to repay the

¹ Plus value of copper, not stated.

² There is evidently an error in the statistics here; £30,000 should probably be added.

cost of working. The following description is based on my personal examination of the mine in 1895, and on information then kindly placed at my disposal by the manager, Mr. J. Corlett. Some details of interest regarding the earlier workings, which are now for the most part inaccessible are added from Sir W. W. Smyth's Reports.

The mine is worked on a lode which crosses the bottom of the valley in a nearly north and south direction, with an underlie or dip westward. Two shafts have been sunk, 70 yards apart, the South Shaft to the depth of 110 fathoms and the North Shaft (in December, 1895) to 174 fathoms. The mine has levels at 12, 27, 38, 50, 60 (the two last in South Shaft only), 73, 84, 96, 110, 121, 136, 146, and 170 fathoms; the longest or pioneer levels were the 146 northward, and the 60 southward. The 'lode' is mainly indicated by a quartz vein, bunchy in character, sometimes only 2 or 3 inches wide or even nipped out to a mere joint in the slate-rock, and sometimes swelling to a width of 3 or more feet, and then often full of crystal-lined 'vughs' or cavities which when first tapped discharge water, but soon dry up. It contains in places ribs and bunches of galena and scattered patches of other minerals, including barytes (in the deeper workings), pyrites, etc. The fissure does not appear to represent a fault of any consequence. The country-rock, which dips steeply north-westward, is a firm dark slate, interbedded at intervals with hard bands of quartz-veined grit (see p. 141), one of which, 3 feet in thickness, was well exposed at the bottom of the North Shaft at the time of my visit. The ore-bodies have shown a tendency to sink northward, being met with at shallower depths in the southern than in the northern part of the mine.

Turning to Sir W. W. Smyth's reports¹ we find mention in 1857 that at 10 fathoms there was a little ore, only a few inches wide; in 1860 the South Shaft was at 40 fathoms, and the lode still small and producing only a little ore; in 1865 some ore ground had been found in the 60-fathom level south, but the "end got into black ground, bedded rather flatly," and not promising; and in the following year it is noted that the same level had "poverty-stricken white quartz for its veinstone." In 1869, in the 110 level of the South Shaft, the lode proved quite poor on the south, but bolder and better on the north; and the discovery of ore in the 96 and 84 north drivings, where there was "a really tolerable lode," led to the renewed sinking of the old [North] Shaft which had previously stopped at 38 fathoms. In 1872 the North Shaft was down 120 fathoms, and the lode there 4 or 5 feet wide, but quite worthless; and in the 110 level half-way between the shafts the vein was also of good size, but calcareous and unprofitable. In 1876, it is noted that the lode at 136 fathoms down was sprinkled with lead and zinc; and in the following year that at 146 fathoms it was "dull quartz with a few large crystals of calc-spar in the cavernous hollows."

In the annual "Mineral Statistics," returns of lead-ore from this mine are given for all the years between 1857 and 1878 inclusive; also for 1880-1, 1891-4, and 1897, amounting in the aggregate to 1,763 tons.

Glencherry Mine.

This name was given to a small mine in the bottom of the Cornah Valley 650 yards east of the North LaxeY Mine, with which it has since been amalgamated. Work was carried on here, chiefly between 1865 and 1875, on a north and south lode with an easterly underlie, which yielded a small quantity of lead ore. Two shafts were sunk, the South Shaft to 15 fathoms, and the Engine Shaft to 35 fathoms, with levels at 15, 20 and 35 fathoms.² Sir W. W. Smyth describes the underground appearances in his reports as follows³:—"In 1866, when the shaft was down 8 fathoms, it was "on a lode 5 or 6 feet wide yielding extremely promising stones of weathered galena with incrustations of green and of white lead ore;" in

¹ MSS. in Woods and Forests Office.

² Information from Mr. W. H. Rowe.

³ MSS. in Woods and Forests Office.

1867, the 15 fathom level had been driven 12 fathoms north, and showed a little ore; in 1868, it is noted that the favourable symptoms had been of short duration, and the ground very changeable—the 20 fathom driving north had a little ore which dwindled away after a few feet; in 1869, the 20 and 35 fathom levels had been driven for some fathoms without finding more than a mere sprinkling of ore; and in 1871, the 35 fathom level had been driven some 15 fathoms, showing a lode 2 to 3 feet wide with no other mineral than a little pyrites in sight.

East Laxey Mine.

Under this title an unsuccessful trial for copper, on which many thousands of pounds were expended, was carried on between 1866 and 1869 in the Cornah Valley 600 yards west of the bridge at Corran (Sh. 8). An adit was driven from the bank of the stream for 65 fathoms with a direction of N. 30° W. on a hard quartzose lode, underlying westward, said to contain little pockets of copper pyrites and iron pyrites; and a shaft was sunk to 20 fathoms, with a level at that depth for 40 fathoms northward. Another adit was driven, for a few fathoms only, into the south bank of the stream. No saleable quantity of ore was produced.¹ Sir W. W. Smyth refers in his report for 1867 to the driving of a level on "a miserable-looking hard vein with but a few specks of copper pyrites here and there"; and in 1868 states that he examined the 20 fathom level for 40 fathoms north, and found a lode all the way, without ore or promise.

East Snaefell Mine.

The company using this title was formed about the year 1864, to test the supposed extension of the Great Laxey lode in the upper part of the Cornah Valley, 650 yards above the 'North Laxey Mine.' A day-level (indicated on the six-inch ordnance map, Sh. 8) was driven S.S.E. into the hill-side, on a gossany clayey 'lode' underlying east, but no metal was found.² Smyth writes of these trials in his report for 1865, that "some short drivings and the sinking of a sump for a few feet have shown that there are lodes in this ground, but nothing of promising appearance, far less productive, has been seen." The company afterwards transferred its operations to the "Glencherry Mine."

Snaefell Mine.

This mine, on which work was seriously commenced about the year 1856 and has been continued, with some interruptions, up to the present time, is situated at the eastern foot of Snaefell on the north branch of the headwaters of the Laxey River, 3 miles N.W. of Laxey village. The lode, which was discovered in the bed of the stream, strikes about N. 20° W. from the mine, but swings to N. 30°–35° W. towards the northern extremity of the underground workings. Its underlie is eastward at about 75° from the horizontal. It consists of a belt of crushed slaty rock, often 'dowky,' interpenetrated by strings of quartz associated with dolomite, calcite, galena, zinc-blende, and a little copper-pyrites, iron-pyrites; and pyrrhotine ("in the form of acute hexagonal pyramids"). Sir W. W. Smyth also records³ impure graphite ("100 and 130 fathom-levels") and manganese spar ("small crystals in small isolated 'vugs' or locks," found about the year 1876). The width of the space recognised as 'lode' varies from 6 inches to 60 feet or more; but its limits are generally ill-defined, and it is said to have 'branches' in places on both sides, with more or less broken country-

¹ From information obtained from Mr. W. H. Rowe.

² *Ibid.*

³ "List of Manx Minerals," op. cit.

rock between; and the lode is considered to be most favourable where these 'branches' fall into it. This broken ground probably marks a line of faulting which may be of considerable magnitude, though the highly contorted and complex structure of the strata precludes any trustworthy estimate of the displacement. The mine is placed on the narrow belt of banded slates with gritty intercalations which form the passage beds between the Barrule Slates on the west and the Agneash Grits on the east, but the deeper northward workings appear to enter the Barrule Slates. At the time of my examination in 1895, it consisted of a single shaft, following the dip of the vein to the depth of 171 fathoms, with levels, below the adit, at 25, 40, 60, 74, 85, 100, 115, 130, 141, 158, and 171 fathoms, chiefly driven northward under the mountain. The most northerly point of the mine was the 130-fathom level, which was 530 fathoms out from the shaft; and the most southerly, the 141 level, out 60 fathoms. The levels communicate with each other by a series of winzes connecting with the adit-level which enters the hillside 100 yards N. of the shaft.¹

While a little ore has been found in many places in the lode, the principal bunches hitherto discovered lay at 60 to 80 fathoms north of the shaft in the upper levels, and at over 250 fathoms north in the lower levels. Including 1900 the total output of ore from the mine since the year 1870 recorded in "Mineral Statistics," is 4,567 tons lead-ore and 8,926 tons zinc-blende.

The galena averages 14 to 16 ounces of silver per ton. The copper-pyrites is sparsely distributed, occurring chiefly where blende is most abundant. No payable quantity of ore has been discovered south of the shaft, either in the deep levels or in the trial adits in the valley below the mine. One of these trials, on the south bank of the Laxey River 200 yards below the confluence of its two main branches, was driven W.S.W. for 80 fathoms to cross-cut the lode, and then southward along the lode for about 80 fathoms farther.

Polished (graphitic?) and slickensided surfaces are very conspicuous in the vein, especially among the darker slates, the striæ on some faces being vertical, and on others horizontal or inclined. The 'dominant dip' of the rocks (see p. 145) in the neighbourhood of the mine is towards N.N.W.; but underground the dips were found to be variable, and frequently towards the unusual direction of N.E. or E.N.E., probably denoting local disturbance along the line of faulting. In one place the lode is cut by a 'cross-course,' which is clearly a later fault, striking N. 30° W. and having southward, the effect of which is to shift the metalliferous vein 8 feet to the westward on the north side. The position of this 'cross-course' in the 141 fathom level (where I examined it) is about 205 fathoms N. of the shaft; the lode is somewhat enriched in its vicinity, especially in blende. One or two small sheared igneous dykes of the basic type so numerous in the Manx Slates were observed in the country-rock adjacent to the lode.

Block Eary and other Trials near Snaefell.

In the valley of the Block Eary feeder of the Sulby River, at the foot of the northern slope of Snaefell Mountain, an adit was driven for 100 fathoms south-eastward in the river-bank S. of the farmstead of Block Eary, and another in the opposite direction in the little glen 250 yards W. of the farm, on a vein which is said to have been similar in character to that of the Snaefell mine, with which it was supposed to be continuous; but no ore of value was discovered.² The Snaefell lode was also sought

¹ A plan and description of the mine is contained in the Official Report of Dr. C. Le Neve Foster to the Home Office on the accident in May, 1897, by which twenty men lost their lives through the poisonous gases engendered by a fire in the timbers of the 130 fathom level. (Blue Book. "Snaefell Lead Mine Accident." 1898.)

² From information furnished by Capt. J. Kewley.

for in the opposite direction, south of the valley of the Laxey River, but Sir W. W. Smyth noted in his report for 1871¹ that only some indistinct fragments of vein were found in these workings. Several other profitless trials were made in Laxey valley between the Snaefell and Great Laxey mines, one of which, known as the Glenfoss level, is briefly described in Smyth's report for 1865.²

Glen Roy Mine.

This mine, on which very large sums were expended both underground and at the surface, is situated in Glen Roy near Riversdale, 2 miles west of Laxey. It seems to have been begun about 1864 as an offshoot of the Great Laxey Company, but was subsequently worked by an independent company, with disastrous results. It was finally abandoned about twenty years ago. As the returns of ore from the earlier workings seem to have been combined with those of Great Laxey the data for estimating its total produce are not available. In the years 1877, 1878 and 1882, when separate returns were made, the aggregate (in "Mineral Statistics") is 9 tons 9 cwt. of lead ore, and 136 tons 9 cwt. of zinc ore. The shaft was sunk to a depth of about 122 fathoms, with levels at 10, 25, 40, 55, 65 [100?] and 108 fathoms, on a north-westerly lode, heading eastward.³ The presence of a large dyke of greenstone in the vicinity of the lode has been noticed in a previous chapter (p. 160). The following excerpts from Sir W. W. Smyth's reports for the years between 1864 and 1882 will serve to show the principal features of the mine:—In 1864 the operations are referred to as a "small trial"; in 1867 we learn that at 18 fathoms there was a better lode of 2 to 3 feet wide, with a gossany leader or branch containing some good stones of lead-ore; in 1868 the 25-fathom level had been driven a few fathoms north-west on the lode, with about $\frac{1}{2}$ -ton lead ore and 1 ton blende per fathom; in 1869 the same level, extended 30 fathoms, had yielded some good ore, and the 40-fathom level, driven some 9 fathoms, showed "a pretty little rib" chiefly of zinc blende, "but there is nothing that savours of more than distant promise." In 1873 the 50 [55] fm. level was a long way north, with one little bunch of ore, while the 65-fathom level had been driven 25 fathoms each way but showed no promise. In 1876 the mine had recently been reopened, and a little zinc-blende was found in the 40-fathom level by a cross-cut through what was supposed to be the wall. In 1877, at the bottom of the shaft below 65 fathoms the lode was only 4 inches wide at one end, and at the other showed two strings with 4 feet of ground between them, but not a speck of lead or zinc. The 65-fathom level had been driven 73 fms. [?] north and 80 fms. [?] south, and in the 25-fathom level a little blende had been found in a portion of the lode turning some 15° west of south. In 1879 the 100 [108] fm. level was 11 fathoms out on "some appearance of a vein, with a few cavities and crystals of dolomite, but utterly sterile for useful mineral." In the following year this level had come upon some good ribby lead ore, but it proved an isolated pocket. And finally, in 1881, we learn that the deepest level, at 108 fathoms, was out 70 fathoms with only one little blink of ore; that the shaft was deep enough for a 122 fathom level; and that an anomalous bunch of a few tons of very good ore had been found in the 25-fathom level in connection with a 'slide.' The next report mentions that the mine was dismantling.

Dhoon or Rhennie Laxey Mine.

The operations known by this name, on which many thousands of pounds were expended without any return, were made for the purpose of testing a supposed lode occurring in Dhoon Glen, 400 yards east of the main

¹ MSS. in Woods and Forests Office.

² *Ibid.*

³ There is some discrepancy in particulars between the plan of this mine deposited at the Home Office (No. 1509 in "List of Plans of Abandoned Mines") and our other sources of information. The Home Office Plan gives the shaft a depth of 108 fms. only.

road from Laxey to Ramsey. The early workings consisted of a shaft sunk in the glen on the 'lode,' from which a little lead ore was obtained. This shaft ultimately attained a depth of about 65 fathoms, with drivings at 10, 18 and 20 fathoms, in the last of which, north-west of the shaft, a little zinc-blende was revealed. All the workings were in the slate rocks. The most ambitious part of the later operations (between 1859 and 1869) took the form of a deep adit-level, starting low down in the great cliff of slate 500 yards S. of Dhoon Bay and going for 315 fathoms in a west-north-westerly direction as a cross-cut to intersect the vein, and afterwards pushed to within about 250 yards of the margin of the Dhoon Granite. The course of the lode is supposed to have been W. 10° to 20° N., with a southerly underlie.¹ The following excerpts from Sir W. W. Smyth's reports supply further information regarding these now inaccessible workings.² In 1858 the vein is described as 4 to 6 feet wide, with occasional spots of lead ore; in 1866 Smyth states, "I regretted to pass through a long series of workings at the 20 fathom level which have proved entirely unproductive; a few small strings only, which run W.N.W. carry some lead ore, but they seem unimportant." In 1868 it is mentioned that the shaft had been holed to the level, but only a little zinc-blende found in the process, and that all the way in the level ($\frac{1}{4}$ of a mile) to its mouth, not an available spot of mineral had been seen. In 1869 this level had been advanced 110 fathoms beyond the shaft, and the end was following a vein through soapy grey slate, but not exhibiting a speck or sign of any kind of ore.

Minor trials in the same glen included a short cross (10 or 12 fathoms) in slate on the spur between two streams, 200 yards E.N.E. of the shaft; and another in the upper part of the glen, a few yards west of the high road, said to have a length of 35 fathoms, and to continue throughout in the tough boulder clay in which it starts.³

SOUTHERN GROUP.

Bradda Mines.

As stated in the introductory notes to this chapter, these mines are probably the most ancient in the Island, and were worked at a period anterior to the oldest records. They seem always to have been carried on fitfully and with long intervals of quiescence, just as during the 19th century. Copper and argentiferous galena have been the principal ores obtained, the latter especially in the northern part of the lode. Permission was asked in 1858⁴ to raise iron-pyrites from the mine, but Sir W. W. Smyth gave the opinion in his report for that year that the mineral was not likely to occur in quantity.

Cumming remarks that these mines "seem to have been wrought to some extent at the beginning of the seventeenth century, but have latterly been almost abandoned."⁵ Chaloner, in 1656, after mentioning the occurrence of lead-ore containing silver at this place, adds⁶:—"The Veins of this Mine, by it's brightness, may plainly be discerned in the Rock towards the Sea; but it seemeth not possible to be wrought, in regard the Sea beats upon it constantly at High-water, unlesse it may be done by Mining within the Land; a tryall whereof were worth the undertaking, in regard of the great benefit that possibly may ensue thereof." Feltham in 1798 ("Tour," etc., op. cit., p. 213) mentions that the mines though closed at the time of his visit, were worked and the ore brought from the shore in boats, and then carted to the smelting house at Port-le-Mary. Woods, Berger and

¹ Information chiefly from Mr. W. H. Rowe.

² MSS. in Woods and Forests Office.

³ Information chiefly from Mr. W. H. Rowe.

⁴ Documents in Woods and Forests Office.

⁵ "Isle of Man," 1848, p. 165.

⁶ "A Short Treatise, etc." p. 8.

Macculloch, early in the past century, found them standing idle, the last-mentioned author stating (in 1819) that they had been abandoned "twenty years ago." A plan of the workings, dated 1826, is preserved in the Office of Woods and Forests.¹

Work was resumed soon after Cumming wrote, as there is a return of 25 tons of lead ore from them in 1850; and similar small quantities are recorded intermittently between this date and 1863, the returns for the whole period showing 178 tons lead ore and 146 tons copper ore. The "South Manx Mining Company" which had been prosecuting the work seems then to have come to an end; but between 1866 and 1875 the "Bradda Mining Company" resumed operations, with a total output, as shown by returns between 1869 and 1874, of 364 tons lead ore and 193 tons copper ore. In 1881 the mine passed into other hands, and a new "Bradda Mining Company, Limited," was instituted, which ceased working in 1884. The returns of this company (1881-1883) give a total of 478 tons copper ore. The output from these mines seems never to have approximately reached the cost of production.

The lode, as already mentioned, is very conspicuous in the cliff on both sides of Bradda Head. On the south it occurs as a nearly vertical rib of white quartz and fault-breccia 30 to 50 feet wide, with well-defined walls rising over 120 feet up in the cliff. It strikes N. 5° E. across the headland for 700 yards and reappears on the coast opposite Creg Harlot (six-inch map, Sh. 15), forming in places the face of the high cliff until truncated by a sharp curve in the coast-line. It is to these sections that Sir W. W. Smyth referred in describing the Bradda Lode as "the noblest surface exhibition of a mineral vein to be seen in Europe."²

At its southern extremity the underlie of the vein is eastward at about 10° from the vertical. The quartz is full of cavities or 'vughs,' and the metalliferous contents are distributed irregularly in detached strings and patches. I am informed that at South Bradda the lode was found to 'pinch' rapidly in the workings below sea level, and that in the deepest part crushed slate rather than quartz was its chief constituent. The fissure appears to mark a fault cutting off the eastward prolongation of the flaggy grits of the headland; but the extremely contorted arrangement of the rocks in this vicinity hides the true relations of the strata. It is important to note that the vein, like most of the metalliferous lodes of the Island, lies close to the main structural axis of the slates (see p. 30).

At its northern outcrop the fissure is less sharply defined, and appears to have split into two or more branches with shattered rock between them, the western branch being distinguished as the 'Bulwark Lode.' In this part of its course a small dyke of (Tertiary?) olivine-dolerite, 1 to 2 feet wide, is seen in the cliff to run along the lode, thus furnishing an especially interesting example of the association of the dykes of this type with the metalliferous deposits. In this case it is evident that the vein was in existence prior to the intrusion of the igneous rock; and no distinct indication is forthcoming to show whether the dyke has been the means of introducing or concentrating the ores in the fissure, as is suggested in some other instances (p. 488). The dyke is probably an offshoot from a broader intrusion visible at low tide on the shore 220 yards S. of Creg Harlot, which strikes away from the lode in the usual direction of the olivine-dolerite group, viz., W. 35° N. Apparently while the main part of the dyke has held to its original course, it has thrown off a branch northward on intersecting the lode. On the opposite or eastward side, the course of the main dyke is indicated by a small outcrop at the side of a fence 250 yards inland, in the same line of strike. The intrusion was seen in the North Bradda mine-workings by Sir W. W. Smyth, who in his report for 1873, after describing the 70-fathom level north of the shaft as being in a cavernous quartz lode with very little appearance of copper, remarks:—"the south driving of the same level has been strangely interfered with

¹ Of doubtful value; probably incorrect.

² Bevan's "British Manufacturing Industries," 2nd ed., p. 15. (London, 1878.)

by trap dykes, which in some places appear to border, but in others cut right across the lode, filling up a great portion of the space between the walls."

The workings on the vein are in three separate groups:—the South Bradda Mine, at the foot of the cliff at the southern outcrop; the North Bradda Mine, in a similar position at its northern extremity; and a set of workings at a higher level, on the top of the headland about half-way between, which connect with an adit-level driven in from the cliff.

At South Bradda the older workings were carried on by means of an adit about half-way up the cliff, driven northward along the lode and connected with shafts from the surface of the headland and with sinkings where the ground was productive. The largest patches of ore seem to have been found in this locality. The later operations include a level over 100 fathoms long, driven upon the lode at a little above high-tide, with a rise connecting with the higher workings; and a shaft sunk from the base of the cliff to a depth of 30 fathoms, with a level along the vein at 20 fathoms, which disclosed nothing of importance.

At North Bradda there is, similarly, a series of old galleries in the face of the cliff, with newer workings descending below sea-level. The shaft at the base of the precipice is stated to have been carried to a depth of 72 fms. with levels at 27, 40, 50, 60 and 72 fathoms, mostly driven northward on the lode. The longest of these levels was the 60 fathom, which appears to have been carried 70 to 80 fathoms N. of the shaft, with poor results. Some ore was won in the 40 and 50 fathom levels, and a little lead in the 72 fathom S. The mine made 200 gallons per minute of salt-water. One of the higher galleries of this mine was driven south to connect with the 'Spittals Shaft,' which was sunk from the upper surface of the headland. The plan of the mine prepared by J. A. Twigg of Chesterfield in 1826, now preserved in the Office of Woods and Forests, shows a through communication between North and South Bradda by an adit a little above sea-level, but this connection is not shown on the later plans to which I have had access. The workings above sea-level were the most productive of the mine both in the cliff and on the top of the headland; and Smyth notes (in his report for 1873), "It is a matter of reasonable disappointment that this great lode both here [North Bradda] and in the southern workings at Spittals Shaft has manifestly deteriorated in depth." The width of the lode in the upper part of the mine was in places between 10 and 11 fathoms.¹ The vein was everywhere 'streaky,' and without continuous ore bodies. A little native copper ('moss-copper') is reported to have occurred in the parts of the mines highest above sea-level. The following minerals from the lode are recorded by Sir W. W. Smyth:—Malachite; Cuprite ("in minute octahedral crystals at the 40 fathom level"); Melanconite; Copper Pyrites; Copper Sulphate (old workings); Atacamite ("copper-ore changed under action of the sea-water—Old Mine, North Bradda"); Galena (argentiferous); Cerussite; Marcasite; Chlorite ("with quartz"); Agate ("parts of the vein-quartz in the Bulwark lode, North Bradda"); Hydrated Oxides of Iron (Ochre and Umber; "sometimes as gossan of lodes as at Ballacorkish and Bradda").²

As the workings are now inaccessible, special value attaches to Sir W. W. Smyth's descriptive reports, from which, in addition to the passages already quoted, the following details respecting the character of the lode have been culled. In 1858, Smyth mentions that at North Bradda "the eastern part of this huge lode presents a rib, between 2 and 3 feet wide, of softer character, which was largely worked for lead ore under the Duke of Athol, and a little is still obtainable in the 'backs.'" In 1859, the workings at South Bradda are described, where the adit had been cleared, the lode cross-cut, and a 20 fathom level driven some distance below the adit, "but although copper-pyrites, galena, iron-pyrites, and carbonate of

¹ For the above details I am chiefly indebted to Messrs. R. Barkell, J. Kewley, and W. H. Rowe.

² See "List," in Transactions I. of Man Nat. Hist. and Antiq. Soc., vol. i., pp. 143-7.

iron are all there, they are in too small quantity to be of any value." It is also mentioned that three shallow shafts, opened on the hill above, and levels driven or re-opened there, had discovered large workings of the 'old men,' but very little ore. In 1860, "from North Bradda, at last, some ore has been raised and sold," a very fair course of lead ore having been found in a winze down about 14 fathoms on the eastern lode. In 1868, we learn, "the Bulwark lode or farthest point W., under the sea, has so far been a disappointment, containing little else than quartz with an agate-like structure." In 1871, the North Bradda shaft was down 9 feet below 70 fathoms, and "here the lode is a great quartzose cellular mass of the hardest character, streaming on all sides with salt water, and containing only small spots of copper ore." In 1872, the workings at Spittals Shaft are described as being 25 fathoms below the adit from the cliff, which reached the shaft at 54 fathoms from the surface, the lode keeping its great size here "in all 50 or 60 feet wide, inclusive of the 'doug' or soft argillaceous lode, and the 'Bulwark' or western quartzose part," but copper ore occurred only in spots. On the last re-working of North Bradda, it is noted in the report for 1883 that the 40 fathom level, driven 50 to 60 fathoms N. of the shaft, had ore said to run 3 or 4 tons per fathom, but "a cross-course had disordered the lode in the end."

Coast south of Port Erin.

If the Bradda Lode be continuous southward in the same line of strike, it should be again intercepted by the coast about $\frac{1}{2}$ mile S. of Port Erin Bay; and we find in this locality a comparatively small but well-marked vein, with an easterly underlie, in the recess of Bay Fine, consisting of quartz and fault-breccia with iron pyrites. The strike of this vein, however, is N. 10° W., which is somewhat to the seaward of Bradda Head; it may possibly be a branch of the main fissure. At Aldrick, a similar recess $\frac{1}{2}$ mile farther south, another fracture is revealed, striking about N. 3° W. and having eastward, which emerges again on the shores of Calf Sound near Carrick Nay (six-inch, Sh. 18) 500 yards farther south, where it forms a broad lode. This has been tested by an adit reported to be 15 to 20 fathoms in length, from which a little copper-ore was obtained. I was informed by a miner who had worked both here and at Bradda that this lode resembled exactly the Bradda vein, of which it is regarded as the prolongation. If the identification be correct, the Bradda vein must have been shifted for 600 or 700 yards to the westward of its strike, either by a change of direction or by cross faulting. It is more probable however that, as at Ballacorkish, the ground is gashed by a set of approximately parallel but discontinuous fissures. There are no doubt later east and west faults here, as in other localities; but it is scarcely likely that these are large enough to carry the Bradda vein to Aldrick.

Ballacorkish, South Foxdale, or Rushen Mines.¹

Though not permanently profitable, these mines have made a considerable output of lead and zinc ore, of which they are the only workings in the south of the Island to yield an appreciable quantity. Their early history is obscure, but the vein appears to have been worked and abandoned prior to 1811.² It is also mentioned by Macculloch in 1819 as an abandoned working.³ The mines lie in the Manx Slates, about half a mile W. of the village of Colby in the parish of Arbory, on the lower slopes of a spur from the hilly axis of the Island. Work was resumed

¹ Unless otherwise indicated, the account of this mine is based on my personal examination of the plans and part of the workings, supplemented by information supplied by Mr. F. Kitto, the manager of the mine.

² G. Woods, "An Account," etc., op. cit., p. 12.

³ "Western Isles" vol. ii., p. 574¹

about 1862 and carried on more or less intermittently at the one or other of two shafts until 1893, latterly under the title of the Rushen Mines. The aggregate returns, as given in "Mineral Statistics" between 1864 and 1894, show a total output of 3,693 tons lead ore, 2,869 tons zinc ore, and 138 tons copper ore.

The mines comprise two separate workings, not connected underground, the main shafts of which are about 600 yards apart. These workings appear to be on different lodes, or otherwise upon a lode which has suffered considerable lateral displacement. The lode or lodes have a general northerly strike, but while in the South or Ballacorkish mine the average direction is 2° to 5° W. of N., in the North or Rushen Mine it is about 10° E. of N. The hade or underlie is in both cases principally westward, at from 10° to 20° from the vertical, but with local deviations bringing it over in one part of the mines to the opposite quarter.

The South Shaft has been sunk to a depth of 75 fathoms, with levels at 12, 24, 36, 60, and 75 fathoms. The longest level is the 60 fathom, which has been driven about 490 yards north and 130 yards S. of the shaft. The North or 'Phosphate' Shaft had a depth at the time of my visit in 1893 of 60 fathoms, with levels at 15, 30, 45, and 60 fathoms, of which the 45 fathoms went 60 yards S. and 260 yards N., and the 60 fathoms about the same distance N, these being the pioneer levels of the mine. In the uppermost part of the mines a little copper ore was obtained, while the lower levels yielded only galena and zinc-blende, the latter chiefly on the western side of the lode. The ores were 'bunchy' and irregular in their mode of occurrence throughout. In describing the uppermost level in the S. shaft in his report for 1869, Sir W. W. Smyth remarks "in the best part of this . . . the lode was as much as 5 or 6 feet wide, with more massive ribs of ore than were anywhere to be seen in the Island except only Foxdale and Laxey."

The galena of the south mine was richer in silver than that of the north, the former being stated to run 15 to 16 ounces to the ton and the latter only 3 or 4 ounces. The water percolating along the lode and pumped from the shafts averaged from 30 to 35 gallons per minute for each mine.

Besides the ores mentioned above, the following minerals are quoted in Sir W. W. Smyth's list¹ as occurring in the vein :—Pyromorphite [phosphate of lead, from which the N. shaft derived its name], Cerussite, Chlorite ("according to Captain Barkell"), and Ochre and Umber [decomposed dolerite?]. The country-rock chiefly consists of rather flaggy slate; thinly bedded grits with slate partings were revealed in a short cross-cut E. in one of the lower levels.

The main geological interest of the mine lies in the relation of the lode to a dyke of olivine-dolerite, and in the cross-faults by which the metalliferous vein is thrown. The olivine-dolerite is apparently one of the Tertiary dykes (see p. 327) which diverges from its W.N.W. course on encountering the lode and follows it for a short distance. It is probably identical with the intrusion revealed in the bed of the Colby River a few yards below the corn mill, and again in the little glen 400 yards W. of Colby under the garden of Ballasherlocke (see p. 185).

As previously stated, the relations of the metallic infilling of this lode to the intrusive rock afford important evidence as to the age of the ore-deposits, a study of the facts leading to the conclusion that although the lode existed as a rock-fracture previous to the intrusion, some part if not all of its metallic contents were subsequently accumulated, therefore attaining their present position at a comparatively late geological period (p. 489).

SOUTH MINE.—The dyke was first reached in the northward drivings of the South Mine within about 200 yards of the shaft and was more or less continuous thence to the end of the levels, accompanying and forming part of the lode, the ore lying sometimes to the east, but oftener to the west of it.

¹ Trans. Isle of Man Nat. Hist. and Antiq. Soc., vol. i., pp. 143-7.

This portion of the mine was inaccessible at the time of my survey, but is described, with especial reference to the intrusion, in Sir W. W. Smyth's official reports. The presence of the dyke is first mentioned in his report for 1870¹; in the following year Smyth notes the adit being stopped "on account of the apparent destruction of the lode by greenstone"; and in 1878, that in a deeper level the "black-rock or dolerite" made its appearance and seemed to militate against the productiveness of the vein. In 1879, he compares the intrusion to the [Carboniferous] igneous rock of Scarlet Point [from which it is, however, distinct, see p. 325] and describes its occurrence in the 60-fathom north level, at that time 210 fathoms out from the South Shaft, as follows:—"I regret to add that the dolerite or black igneous rock . . . has for the last 35 fathoms completely overpowered the lode so that in the latter part hardly a trace of it is seen. Before that, it had accompanied the lode in a narrow band of 6 inches, which had appeared to do its productive qualities no harm. . . . There are hitherto but few precedents to go upon with reference to this dolerite and basaltic rock, but it is evident it is a question of much importance in this part of the Island from its action here, as well as at Central Foxdale, and in a minor degree at Bradda." In 1880, in describing the further progress of this level, he mentions that the lode was a mere string, not yet out of dolerite in which it has "been encased for 80 fathoms length,"—thus distinctly implying that the 'lode' proper is newer than the intrusion.

NORTH MINE.—In the North Mine, where it was practicable in 1893 to examine the intrusion in the lower levels, I found the principal dyke to have a thickness of from 6 to 12 feet. Small fliers of the same rock occurred among the lode-stuff and were themselves sometimes dappled with lead-ore throughout, this association suggesting that part, at least, of the metalliferous contents of the vein had been introduced along with or later than the dolerite. In his earlier reports quoted above, Sir W. W. Smyth evidently inclined on the whole to the miners' opinion that the lode was intruded upon and cut out by the dolerite; but with the progress of the workings in the North Mine, and influenced, no doubt, also by evidence obtained about this time at Central Foxdale (p. 515) and Langness (p. 538), he abandoned this opinion; and in 1883 in describing the 30 fathom level of the new shaft he remarks that the ground was strongly invaded by dykes of dolerite, "the supposed prejudicial effect of which on the lode is, I think, not confirmed at this place, since there are parts in which a rib of this rock from 4 to 8 inches thick was flanked on either side by a branch of lode with lead and zinc ore."

We learn from the report for 1881 that in the upper level the lode was 4 to 8 feet wide, "having in places very beautiful examples of gossany lead-ore with white and green lead-ore;" and in 1883, that in the 30 fathoms the lode was difficult of definition, in places 14 feet wide, and two levels on it, though the branch usually opened on was about 2½ feet wide, mostly occupied by soft gossan with abundant minute crystals of white lead ore.

From information obtained at the mine, it appears that in these workings the dolerite was continuous southward to the end of the longest driving, 60 yards S. of the shaft; while northward it was lost, at about 90 yards from the shaft in the 45 fathom level; at 95 yards in the 60 fathom level; and at about 100 yards in the 75 or lowest gallery, probably striking off westward upon leaving the lode, with the same course that it held before intercepting the fissure, as it was not touched in the east and west cross-cuts made farther north. The dyke was disturbed and shattered in places, probably by transverse movements after its consolidation. It is not clear whether the intrusion is continuous from the South to the North mine, or whether we are dealing with separate and parallel branches. The end of the most northerly driving from the South Shaft lies about 240 yards east of the end of the most southerly driving from the North Shaft, and the character of the intermediate ground is unknown. It seems most probable that the nodes constitute

¹ MSS. in the Woods and Forests Office.

a group of roughly parallel discontinuous N.—S. fissures, and that the intrusion in traversing the tract from east to west broke across from one to the other, and followed each in turn for a short distance only. The greater portion of the metalliferous deposits appear to have been afterwards concentrated in the fissures around and a little beyond the places at which the dolerite crosses them.

In the South Mine two large transverse east and west displacements of the vein have been recognised by the miners. One of these, known as the 'Dowk Lode,' consists of a belt of crushed soft ground 66 feet broad, which sets in 15 yards north of the shaft and is said to shift the metalliferous vein 190 feet westward. The second, named 'King Slide,' occurs 130 yards north of the shaft,¹ and is supposed to displace the lode westward on the southern side. The miners' identification of their 'lode' beyond these breaks is of course open to doubt, and Sir W. W. Smyth refers to the workings north of the 'Slide,' in his report for 1875, as on "a new north and south lode at about 24 fathoms beyond the old one," and in 1880 mentions the "Blende lode," 52 fathoms east from the main lode. In Great Laxey and other Manx mines working north and south lodes, though east and west displacements, recognisable as normal faults, are not uncommon, they are never of this magnitude (p. 487).

Bellabbey or Ballasherlocke Mine.

The site of this extensive but unproductive trial is on the eastern bank of the little glen $\frac{1}{4}$ mile west of Colby (Sh. 16), 760 yards north of the main road to Port Erin, and about 700 yards east of the 'Phosphate Shaft' of the Ballacorkish Mine. The work seems at first to have been carried on in connection with the trial in the cliff at The Slock (p. 536) 2 miles farther north, under the designation of the "BELLABBEY AND FALCON CLIFF MINES." The earlier workings appear to have been the adit levels in the glen north of Bellabbey. These were referred to in Smyth's official reports for 1862 and 1869; we learn from the same source in 1870 that the adit level had been driven 87 fathoms and discovered only a string of mixed lead ore and blende 2 to 6 inches wide and a few yards in length. A shaft, ultimately attaining (in 1876) the depth of 72 fathoms, was then sunk and levels driven, mostly northward, from it at 12, 24, 36, 48, 60, and 72 fathoms, the longest being the 60 fathom which went 140 fathoms. Besides the ore in the day level above described, a little galena was found in the 36 fathom level north and in a few other places, but nowhere in profitable quantity. The 'supposed lode' ran approximately north and south, with easterly underlie, and consisted of quartz (gossany at the top), crush-rock and 'dowk.' Water was raised from the mine by the pumps at the rate of 100 gallons per minute.² In Smyth's report for 1872, when the shaft was down 31 fathoms, it is stated that the driving had "met with a little copper pyrites and zinc blende, but scarcely any lead ore." In his report for 1876 there is the following passage:—"A very curious and exceptional little deposit of copper ore occurred in a 'warp' or loop of the vein in the 48 level north 60 fathoms from shaft; a bunch, only a few feet in length, and, as I fear, only some 9 fathoms in height, but reaching at its best 12 or 14 inches in thickness, assaying 13½ per cent."³ It is also mentioned in this report that a cross-cut at the 72 level 9½ fathoms beyond the old lode had cut another lode also dipping east but at a steeper angle. In 1880, Smyth described a cross-cut at 60 fathoms going out west for 58 fathoms without attaining any results. This appears to have been the last work done in the mine.

¹ These displacements have been indicated on the published geological map, but much exaggerated owing to the small scale of the map.

² For most of these details we are indebted to Mr. R. Barkell, the late manager of the mine.

³ MSS. in Woods and Forests Office.

Slock Trial (*apparently worked as the Falcon Cliff Mine*).

This consisted of a level driven into the face of the high precipitous cliff nearly opposite The Stacks, about a mile N. of Fleshwick (near Y Slogh, of six-inch map, Sh. 12). The country-rock is banded slate, and many dykes of microgranite of the Foxdale type, of greenstone, and of olivine-dolerite, are exposed in the immediate vicinity (see p.p. 150-1). The 'lode' consists of fault-breccia, which is said to have contained a little lead-ore at the mouth of the level but none farther in. Its direction is slightly N. of E. at the entrance of the adit, but is reported to have changed to S. of E. inside.¹ The trial was made between 1860 and 1870. Sir W. W. Smyth's report for 1866 contains the following comment on it:—"A fair amount of work done in the past year has only made appearances worse than before."

In "Mineral Statistics" the Bellabbey and Falcon Cliff Mines are credited with returns in 1872 and 1876-8, amounting in the aggregate to 59½ tons copper ore, 22 tons 17 cwt. lead ore, and 16 tons 8 cwt. zinc ore.

'Iron Spout' Mine.²

This name was applied to a small trial-shaft which was sunk, about the middle of last century, to a depth of 10 or 15 fathoms on the E. bank of a rivulet ½ mile E. of Colby and 300 yards N. of the highroad. No ore seems to have been found, but some of the weathered debris on the spoil-heap shows slight copper staining. The shaft has passed through a highly-sheared 'greenstone' dyke curiously dappled with the green stain.

Glenchass Mine.

The site of this mine is in the north-western corner of Perwick Bay ½ mile S.W. of Port St. Mary, where the vein is intersected by the cliff in the recess known as *Collooway* (six inch, Sh. 15). The date of the first working is uncertain, but was probably before the end of the 18th century; Macculloch in 1819 mentioned the place ("Glensash, near Port la Marie") as being at that time abandoned.³ Toward the middle of the past century operations were resumed, at first as part of the Bradda mining sett and afterwards as an independent company, but the mine did not at any time yield ore in paying quantity. The first workings consisted of an adit-level driven into the cliff along the course of the lode, which runs N. 18° to 20° W. with an easterly underlie. Afterwards, a shaft was sunk from the surface 200 yards inland, which reached a depth of 50 fathoms, with drivings, chiefly southward under the sea, at 15, 23, 38 and 50 fathoms. Some small 'bunches' of argentiferous galena of high quality, and kupfer-nickel (arsenide of nickel), are said to have been found in the sole of the day-level, this being the only known occurrence of the latter ore in the Island.⁴

From Sir W. W. Smyth's official reports⁵ we learn that the mine was in operation in 1857; but working appears then to have been suspended until 1861 when the 15-fathom level was being driven north and south, exhibiting a little lead-ore in the latter direction; in 1862, the shaft had been sunk

¹ From information supplied by Mr. Barkell.

² *Ibid.*

³ "Western Isles," vol. ii., p. 575.

⁴ Recorded by Sir Warrington W. Smyth in his "List of Manx Minerals" (Trans. I. of Man Nat. Hist. and Antiq. Soc., vol. i., p. 146), where it is stated that the ore was "found in small quantities about 1858 to 1862"; according to the same authority, Millerite (sulphide of nickel) occurred in "delicate capillary crystal vein-stuff at a trial shaft at Rhenas, south of Kirk Michael" (see p. 547).

MSS. in Woods and Forests Office.

to 50 fathoms, and the "lode in the 38 fathoms [south] is of good size, but valueless"; in 1863, this level had cut a slide introducing water and a better-looking lode, 3 feet of which carried some steel-grained galena, while the 50-fathom level south showed nothing of promise. The report for 1865 records the collapse of the shaft "which had been put down among old workings, and appears to have been subjected to a sudden pressure by the fall of their walls." The accident brought the operations to a close, and the failure of the mine is locally held to have been due to this cause alone; it is important therefore to note that Smyth's report for the previous year (1864) contains the opinion that "this lode has always appeared to me a hopeless blank."

The Glenchass lode has been supposed to continue its course northward to the coast between Bradda Head and Fleshwick, where it has been sought for in some small trials in the vicinity of a branching dyke of olivine-dolerite at *Lhoob ny Charran* (Sh. 15). An intermediate trial in the interior, close to the hamlet of Bradda West, known as the WEST BRADDA MINE, consists of an adit driven 24 fathoms, with a sump of 5 fathoms, on a lode striking somewhat west of north and hading east, which showed traces of blende and lead.¹ In referring to this trial in his report for 1882² Smyth states that the lode had been tested by the old Foxdale Company 40 years previously, and expresses doubts whether it really coincides with that of Glenchass.

Castletown Harbour.

The occurrence of a little galena at this place is not only interesting as affording the only known locality³ for this ore in the Carboniferous Limestone of the Island, but also because the ore is associated, like the copper pyrites of Langness, with olivine-dolerite (Tertiary?) dykes. Cumming in 1845 described the circumstances as follows:—"This dyke has greatly altered the limestone, and more particularly in those places where it encloses a mass of limestone betwixt two of its branches. In this crystallised and altered limestone we meet with thin strings of galena."⁴ During the mining excitement in the Island some 20 years later, a small trial was begun at this place which was alluded to by Sir W. W. Smyth, in his report for 1867 in the following terms:—"At Castletown, a great cry has been made about a discovery of ore in the limestone rocks bordering the harbour. A shaft is now sinking, but in it I found no trace of vein, and it remains to be seen by driving a cross-cut from it whether anything be there on which a mine can be opened."⁵

Langness Copper Mines.

The prolonged and expensive series of trials on the western shore of Langness on some small copper veins known to Cumming⁶ in 1845 seems to have been commenced about 1875, as we learn from Smyth's report for that year,⁷ that "some strings and vein-like deposits of occasionally 2 or 3 feet in depth have been opened upon the foreshore and yielded some very good

¹ From information furnished by Mr. W. H. Rowe.

² MSS. in Woods and Forests Office.

³ There is a local belief that lead ore occurs also in the limestone at Balladoole, a little to the north of the foreshore; but the evidence offered is unsatisfactory.

⁴ Quart. Journ. Geol. Soc., vol. ii., pp. 331-2.

⁵ MSS. in Woods and Forests Office.

⁶ Cumming says, "I may also mention that along the side of the dike cutting the southern point of Langness, and in a narrow gully, I have met with fine veins of copper in the schist." Quart. Journ. Geol. Soc., vol. ii., p. 332.

⁷ MSS. in Woods and Forests Office.

copper pyrites." The work was prosecuted at various spots from that time until 1880; and after being at a standstill for a few years, was, towards the end of the decade, resumed near the southern extremity of the headland, but has since been again suspended. The strings of ore were first discovered in the Carboniferous Basement Conglomerate, but most of the workings have passed into the underlying slate. As at Ballacorkish, North Bradda and Central Foxdale, the close association of the metalliferous deposit with intrusions of olivine-dolerite lends considerable geological interest to the matter. Unfortunately in spite of the heavy expenditure of capital the total quantity of ore yet obtained has been quite insignificant—only 10 tons 18 cwt. of copper pyrites standing to the credit of the mines in the official returns ("Mineral Statistics" for 1890 and 1892). The direction of the supposed lodes is approximately north and south, with an easterly dip. The strings of ore have been found alongside or in close proximity to small olivine-dolerite dykes that fill the fissures.

The most northerly working is a small trial-pit just above high-water mark on the foreshore of Castletown Bay 420 yards N. of Langness Farm; this has a depth of 26 feet, starting in Carboniferous Limestone, and ending in dark Basement Conglomerate.

The next is a shaft, 320 yards S.W. of the above-mentioned farmstead, sunk to a depth of 12 fathoms, on the raised beach near high-water mark, the upper 50 feet being in conglomerate and the remainder in slate. From the bottom a cross-cut was driven westward under the shore, at first in slate but afterwards in conglomerate, and is described as follows in Sir W. W. Smyth's report for 1876:—"This passes through mottled slaty rock beneath the Conglomerate and at thirty fathoms out has intersected the vein of 2 or 3 feet thick including a 'black stone' or trap and with some good portions of yellow copper ore in it."

The most extensive trial of the series is situated on the top of a low cliff 225 yards farther south, where a shaft has been sunk vertically in slate to a depth of 44 fathoms, with drivings westward from it under the shore. The shaft is said to have intercepted the eastward dipping lode at 30 fathoms from the surface. The lower part of the mine was flooded during my stay in the neighbourhood, but I was able in 1893 to examine a cross-cut to the lode at 12 fathoms depth, in which the junction of the slate and conglomerate was seen to occur at a small fault striking N. 8° E., and to be accompanied by a rib of intrusive dolerite like the branching dyke so beautifully exposed on the foreshore above (p. 195). Strings of copper pyrites lay along the junction of the dyke with the conglomerate, and to a minor extent at its junction with the slate. On the opposite side the ore in places permeated the margin of the igneous rock, like the lead-ore at Ballacorkish (p. 534), and was most plentiful in a bifurcation of the dyke.¹

The 40 fathom level was described by Sir W. W. Smyth in his report for 1878, as a cross-cut running S. of west for 35 fathoms in clay-slate, with short drivings along a string running N. and S. at 18 fathoms from the shaft, and along a second a little farther out having a slightly different course, both utterly barren and devoid of promise, leading to the conclusion that the bunch or two of ore in the overlying conglomerate were extinguished at this depth in the slate.

The evidence on the foreshore shows that the relation of the dyke to the lode is the same here as at Ballacorkish and North Bradda, an intrusion striking W.N.W. across the headland (p. 177) having been diverted northward for a short space by the fissure, but soon escaping from it and going off W.N.W. again. The ore in places impregnates the matrix of the conglomerate as well as the dyke-rock, and must have been concentrated in its present position either during or after the intrusion. It is important to note that both here and at Langness Point the strings of ore occur only in

¹ Our thanks are due to the engineer and captain of the mine for facilities afforded on this and other occasions.

the proximity of the dykes; at the same time, there are many more of these dolerite dykes in the neighbourhood which are not accompanied by metalliferous veins.

The course of the 'lode' of the 'above mine after it is abandoned by the dyke is indistinct, and does not appear to give rise here to a displacement at the surface; though it may possibly be prolonged into the sharp anticline breaking northward into a small fault which brings up the oval inlier of conglomerate among the limestones on the foreshore N.W. of Langness Farm (p. 195).

Southward of the shaft, at a distance of 200 yards, an adit has been driven into the cliff through banded slates traversed by small sheared pre-Carboniferous dykes of 'greenstone,' and 300 yards south of this again, just beyond The Arches (p. 190), there is another adit 36 fathoms long, in the Carboniferous Conglomerate.

The remaining workings are in slate at Langness Point, east of the boundary of the Carboniferous rocks. Here, on the south shore of *Port Bravag* (6-inch, Sh. 19) 200 yards east of the extremity of the headland, a dyke of dolerite a foot or two wide, striking N. 8° to 15° E. along a fissure in slate, showed a string of copper pyrites along its western side. To test this, a shaft was sunk to 26½ fathoms on the ridge about 100 yards to the eastward, and a north-west cross-cut commenced to intercept the lode, but was not completed. Specks of galena were found on joint-faces in the slates of this level. A smaller pit was then sunk to 8 fathoms in close proximity to the fissure, and a short cross-cut driven from it to the dyke, but the result was discouraging. The present surface of the slate at this point is nearly identical with the ancient floor on which the Carboniferous Conglomerate originally rested (p. 191), so that the disappearance of the copper-ore downward in this place as well as in the previous workings suggests that these particular metalliferous strings tend to die out on passing down from the conglomerate into the slate-rocks.

The cliffs on the eastern side of Langness have been tested in several places by short excavations along planes of dislocation and crushing in the slate, but without revealing anything of promise.

NORTHERN HEMATITE GROUP.

Reference has been made in preceding chapters to the occurrence of hematite iron-ore in the veins which traverse the slate-rocks in the north-eastern part of the massif, and to the probability that it may indicate a former overlap of the New Red strata upon the Manx Slates in this quarter (p. 125 and p. 291). So far as is known, it is only in the north-eastern district that lodes of this mineral occur among the slates, though chalybite (carbonate of iron), and iron pyrites are abundant constituents of all the metalliferous veins, and pyrrhotine (magnetic pyrites) is also present in some places. The supposition that the hematite may, as in Cumberland, be connected with the former extension of the Triassic rocks over the area is greatly strengthened by the discovery in the deep borings in the extreme north of the Island (Chap. VII.), of Triassic rocks of considerable thickness, resting on the denuded edges of Carboniferous strata, the latter being always stained and veined with hematite.

From the conspicuous aspect of this red ore in considerable veins in the cliff on both sides of Maughold Head (p. 125), its presence must have been known in early times. As mentioned in the historical introduction to this chapter, we know that the mine at Drynane was working in the year 1700, but no particulars are forthcoming respecting the operations previous to the nineteenth century; they probably consisted of the older part of the adit-levels into the cliff, which have since been driven, at intervals, farther and farther inland. Though in the aggregate a large quantity of ore has been obtained from these mines (see Table, pp. 496-7), the output does not appear to have been sufficient, at any time of which we have trustworthy record, to meet the working expenses, and the mines have consequently been

practically abandoned since about 1874.¹ Two separate lodes or sets of lodes have yielded the chief production, the first that which traverses Maughold Head, and the second running parallel inland $1\frac{1}{2}$ miles farther westward, known as the Ballajora (Ballagorra of Ordnance map) or Magher-e-breck lode. Besides these, several minor trials have been made in the district, but all apparently without result.

Maughold Head Mines.²

On the northern side of Maughold Head, at Stack Mooar, a great vein of fault-breccia and quartz, with cavities containing hematite, strikes in a south-easterly direction across the foreshore and into the cliff, with an exposure almost equal to that of Bradda Head in size and interest (p. 125). Its width at the foot of the cliff is about 40 feet, and it fades or dips north-eastward at 15° from the vertical. The most important of the old workings at this point is said to have consisted of a deep adit-level driven in from a little above high-water mark for 95 fathoms, with cross-cuts for 5 or 10 fathoms both ways at the end, but it appears to have yielded no appreciable quantity of ore.

Better success attended another opening on the lode, known as the GLEBE MINE, about $\frac{1}{2}$ mile S.E. of the above and close to Maughold village. At this place, about 100 yards N.W. of The Vicarage, a shaft and some shallower trials were sunk, and two levels driven on the lode, the lower going south-east for 196 fathoms and north-west for 212 fathoms. This work, according to Cumming, was principally done by a company formed in 1836; and a few years later, when a Glasgow gentleman became sole lessee of the Maughold Mines, the annual shipment of hematite from the district is stated to have been about 500 tons per month,³ seventy men being employed. The south-eastward driving of the Glebe Mine appears to have passed about 100 yards to the north of Maughold Church, and if prolonged in the same direction would have emerged in the cliff above Traie Curn, close to the extremity of the headland. Hence the lode which was followed cannot directly coincide with that of the Southern or Dhyrnane Mine next to be described. Indeed, the veins of this district in spite of their apparent strength in the cliff-sections appear all to be of limited length, forming a group of impersistent converging or radiant fissures, of which those which strike towards points between north and west are more or less metalliferous.

Drynane Mine.

This term is applied to the workings on the southern side of Maughold Head, in a little inlet 500 yards east of Port Mooar (Sh. 8). As mentioned in the footnote on p. 126, the name Drynane, written Dhyrnane, is erroneously affixed on the 6-inch Ordnance map to another inlet 200 yards farther north, in which an adit has been driven to procure umber. The Drynane Mine proper consists of a level going in from the cliff for 320 fathoms in a N.N.W. direction on a lode dipping east, with sumps on ore bodies at 10 fathoms and 37 fathoms from the entrance, and connected with a shaft from the surface at 70 fathoms. A large quantity of hematite was obtained between the mouth of the level and the shaft, but very little farther in. The chief work was done between 1857 and 1874, and is described in Sir W. W. Smyth's reports to the Woods and Forests Office, from which the following abstracts are taken. The report for 1858 states that in driving north, the level passed through two bunches of ore, the first small, but the second 8 to 10 feet wide, and capable of remunerative work; but

¹ Some exploratory work was done, on the old workings, a year or two ago, but has led to no result.

² For information regarding the old workings I am chiefly indebted to Mr. W. H. Rowe.

³ "Isle of Man," p. 311.

in the two following years we learn that no more ore had been found, though a shaft had been sunk on the vein, and a 10 fathom level driven north and south. In 1861, the adit was 95 fathoms in [beyond shaft?], but with "no appearance of promise, although the lode is some 15 feet wide. The south level has also been advanced a long way without any farther discovery of ore. The mineral is so evidently disposed in discontinuous 'bunches' that the prospects of the mine are extremely uncertain." In 1863, the adit was 250 fathoms in, but the lode had dwindled till there was scarce a vestige of it. In 1864 we read, "On careful examination I saw that the drift was really carried on in the lode, and that it occasionally formed a vein of a foot or two in width, but utterly valueless." The later reports contain only passing reference to the workings, until 1873 when it is noted that a long way in the old level and to the east of it, on climbing a rise some 7 fathoms up, a rib of ore of minor importance was seen, "not to compare with the old deposits worked away years ago."

The Umber Mine level mentioned above, which was last in operation between 1887 and 1893, appears to be driven on a decomposed dyke of olivine-dolerite having the usual north-westerly direction. On a plan in the possession of Mr. W. H. Rowe this is shown as intersecting the Drynane level a short distance from its northward termination, with indications that the dyke may have slightly displaced the lode. It is to be regretted that no further evidence is available as to their relations.

Ballajora Iron Mine.

These workings, from which a fair amount of hematite was marketed, were carried on between 1858 and 1874 on N. and S. lodes, dipping eastward, close to the farmstead of Margher-e-breck (*Magher* - of old one-inch Ordnance map, *Mangher* of new) in the parish of Maughold. There are two old shafts N. of the farm, one said to be 18 fathoms and the other about 30 fathoms deep, in the vicinity of which the chief bodies of ore were found; an adit connected with these workings has its mouth in a cross-cut 250 yards S. of the farm. The lode seems to have been very irregular, and in its northern portion to have consisted of two branches.¹ A few descriptive details have been gleaned from Sir W. W. Smyth's reports, as follows²:—In the report for 1859 it is mentioned that the lodes called No. 1 and No. 2 have proved large and capable of yielding a fair return of iron-ore, but "unfortunately a great proportion of this is carbonate of lime and iron yielding a percentage of iron [too small] to bear the expense of carriage." In 1861, the No. 1 level had been driven a long way "in a large lode of impure carbonate of iron," while "the 'School-house lode' has yielded some few cargoes of first-rate hematite, but where hitherto opened, averaging from 1 to 2 feet wide, is not large enough to insure a remunerative mine." In 1872 ("Ballajora and Maughold Head Iron Mine") it is noted that the adit level in the S. ground had opened in a new lode when 20 fathoms in and showed "2 to 5 feet wide of a fair quality of hematite"; and in the following year "two stopes and a sink below the adit" are mentioned in these workings which soon afterwards fell into abeyance.

Other trials for iron-ore, regarding which little or no information has been obtained, are indicated at several places in this neighbourhood; on the N. side of the Smithy at Ballasaig there is a large spoil heap, marked "Iron Mine" on the 6-inch map. (Sh. 5); similar though less conspicuous traces exist in a field 250 yards S.E. of the Wesleyan Chapel at Ballagorra; 350 yards N. of this chapel is the obliterated mouth of a level which was driven for 100 yards into the hill-side; and another level, marked "Iron Mine" on the 6-inch map opens into the cliff 500 yards S. of Gob ny Garvain. (See List at p. 552.)

¹ The above information has chiefly been obtained from Mr. W. H. Rowe.

² MSS. in Woods and Forests Office.

MISCELLANEOUS TRIALS.

Abbey Lands Mine.

This designation was applied to a trial made between 1865 and 1872 on the banks of the tributary to the River Glass known as the *Sulby River*, 1,150 yards N.N.E. of the bridge at Abbey Lands (six inch, Sh. 10). It consisted of a shaft with drivings, on the east bank of the stream, and a short adit on the west bank. Smyth mentions it in his report for 1866¹ as a "sinking on a lode coursing north-east." The supposed lode is probably the belt of crushed ferruginous slate still to be seen in the bed of the stream a few yards above the ruins of the mine. In his report for 1867, the same authority states that there was a single driving east at 28 fathoms, the vein containing calc-spar and copper pyrites; in 1868, we learn that the shaft was idle, but a trial adit 100 fathoms farther south showed another lode, of better character but with no metallic substances; in 1869, a 27-fathom level was being driven west to cut this (north-and-south) lode; in 1870, the 28-fathom level had been driven 40 fathoms on a lode north-westward, of which 13 yards in length had been slightly ore; in 1871, when only the 27-fathom south level was driving, Smyth refers to "the hitherto obscure character of this piece of ground"; in 1872, the 27-fathom level had apparently intercepted the second vein mentioned above, which proved to be a large lode but with no metallic substances of any value, and the work was then stopped. In reporting on a proposed assignment of the lease in 1883, Sir W. W. Smyth stated: "I have on several occasions examined these operations underground, and never yet saw anything of a promising character, or that would give ever so small an amount of saleable ore."²

Ballaglass or Great Mona Mine.

Large sums of money were expended upon this trial of a small north-and-south lode discovered in the bed of Cornah River 1,050 yards E. of the high road from Ramsey to Laxey. The workings commenced about 1854; and in 1857 Sir W. W. Smyth reported that much spirit was being shown in driving the 10 and 24 fathom levels, on a vein with small portions of copper, zinc and lead, but too narrow to warrant much further outlay. In same year there is a record of 9 tons of lead ore and 8 tons of zinc ore to the credit of the mine in "Mineral Statistics," which appears to be the only return made from it. The mine was then suspended for some years, but restarted by the Great Mona Mining Co. in 1866, with no better success. In 1867, Smyth noted that a few stones of ore had been raised; and in 1868, that the shaft was down to 50 fathoms, with no improvement. This appears to have been the depth attained when work was abandoned. The lode is said to have been nowhere more than 6 to 12 inches wide, and to have had an easterly underlie. A small uncrushed igneous dyke of peculiar character traverses an E.—W. joint or small fault in the slaty flags immediately to the westward of the mine (see p. 140), and must be intercepted by the lode. An intrusion of different character has been encountered in the workings, as shown by the fragments of sheared 'greenstone' contained in the spoil-heap.

Ballaskeg Mine.

The Great Mona Company also drove two levels (the longest said to be 60 or 70 fathoms) into the cliff 700 yards N. of Port Cornah, on an E.—W. lode containing traces of copper ore, which were known as the BALLASKEG MINE. Another level was driven, equally unprofitably, into the side of the valley near Corranry Bridge.

¹ MSS. in Woods and Forests Office.

² *Ibid.*

Barony Mine.

This name was given to a small trial for copper made many years ago on a conspicuous N.—S. lode exposed on the foreshore 200 yards S.W. of Port Cornah, as described in a previous chapter (p. 129). The shaft, on the low cliff, is said to have been sunk 15 fathoms, and a level driven S. from it at 10 fathoms, until stopped by water, on a good gossany westerly dipping lode with some carbonates of copper. A cross-cut adit was afterwards driven from Port Cornah.¹

Baldwin Mine.

This old mine, the site of a long and obstinate trial with the most meagre results, is located on the east bank of the River Glass opposite the hamlet of Baldwin. A plan of the mining sett in the Woods and Forests Office, dated 1864, shows two parallel lodes, "No. 2" and "No. 3," 40 or 50 yards apart, striking approximately N.N.W., intersected by other two ("No. 1" and "Wheelcase Lode") similarly parallel and the same distance apart, striking E.—W., but these lodes were probably more or less imaginary. From the papers accompanying this plan, it appears that a level had been driven in the first instance by the Isle of Man (Foxdale) Mining Company, and abandoned. Later, sometime between 1850-55, an attempt was made by other parties to sink a shaft; and finally, in 1862, a lease was granted to the "Baldwin Mining Company, Limited," and work commenced in earnest. In 1873, we find it stated that about £20,000 had been expended, and ore sold to the value of £168 3s. 3d. only, with some 5 or 6 tons more at the surface partially unwashed. Sir W. W. Smyth's reports contain many details of the workings. In the report for 1863 we learn:—"From the bottom of the shaft, now 17 fathoms deep, a cross-cut is driving N. and S. to intersect the three veins which have been seen at the surface. The southern one is without promise, but the ground looks more favourable in the direction of that lode which at a shallower level had last year yielded some large lumps of lead-ore." In 1867 the shaft was 66 fathoms deep, with drivings; in the 42-fathom S. level a little ore had been obtained on the hanging side. In 1868 the 42-fathom level was out no less than 140 fathoms from the shaft; and "one little course of ore is yielding lead and blende ores, rather in cwt. than in tons" and hardly worth the timbering. In 1870 the 66-fathom level on No. 2 lode is mentioned as having for about 14 fathoms yielded a fair amount of ore, but improvement was still needed. In 1871 a winze had been sunk 11 fathoms, and about 12 fathoms of a 77 fathom level driven "unfortunately finding only poverty beneath." The following year we learn that the capital of the company was exhausted.

Ohio, otherwise East Baldwin Mine.

The ruins of this mine may be seen in the East Baldwin valley on the east bank of river 50 yards north of the mill at Ballawyllin. It seems to have been commenced in 1866, and furnishes another example among Marx mines of long and costly working with the most insignificant result. It is mentioned in Smyth's report for that year as "a small shaft sinking on a not very pronounced vein," and reference is made in the following year to the unwarranted excitement in Douglas over a surface-discovery at the mine. In 1868 Smyth notes that a 10-fathom level showed the "lode of a very confused and ungainly appearance," and that no ore whatever was being raised. In 1869, the mine was down to 35 fathoms, "but there is here a junction of veins with an exceedingly puzzling piece of ground to unravel. . . . a little good ore had been met with in one place for 2 or 3 fathoms in length," in the 25-fathom level. In 1870, the lode was being cut in the 50-fathom level, but the little ore obtained was from a sump in

¹ From information obtained from Mr. W. H. Rowe.

the 35-fathom level, "which is the only exception to the mass of confused and broken black ground." In his next report Smyth states that the mine was sunk to 60 fathoms, and that a level at 50 fathoms was 25 fathoms long "with nothing of promise till close to the end, where came in a favourable looking branch of zinc-blende." In 1872, with the shaft at 70 fathoms, it is noted that much driving had been done, "but with the curious result that neither the E. and W., nor the N. and S. lode can be found ore-bearing except in the one limited bunch" previously recorded; and in 1873, the 70-fathom level had been driven some fathoms east and west "in black slate country, and showing not a spark of any useful mineral," while the 60-fathom level was driving north on a N.-S. lode, but without a trace of ore. After which it is not surprising to read in the following year that the mine had stopped. It was restarted, however, by "The Manx Silver-lead Mining Company, Limited;" and Smyth noted in 1876 that a little ore had been scraped up in the 36-fathom level from the skirts of the original bunch; and in 1878, that the shaft was down to 92 fathoms, and that it was intended to carry it down to 104 fathoms—an intention which does not appear to have been fulfilled.

The only returns from this mine published in "Mineral Statistics" are in the years 1872, 1874, and 1875, the total amount being $24\frac{1}{2}$ tons lead ore and 39 tons 8 cwt. zinc-blende.

Douglas Head Mine.

Some utterly profitless mining work was done on Douglas Head (Sh. 13) between 1865 and 1871, consisting of a long adit driven in from the cliff at the southern side of the headland, and a shaft on the summit S.W. of Fort Anne Hotel. The character of the operations will be understood from the following extracts from Sir W. W. Smyth's reports:—In 1865 the report states that "a shaft had been sunk for 14 fathoms, and a couple of fathoms driven on a lode coursing N.E. and S.W. with 'umbery' gossan, but no appearance of ore; while a cross-cut adit was driving from 'Billy Gilbert's harbour,' which will have to be pushed from 60 to 70 fathoms in order to meet an expected lode." In 1866, the level driving in from the sea had "no appearance whatever of a promising character"; in 1868, it had a length of 80 fathoms in hard ground [Lonan Flags] costing £13 to £16 per fathom, "the vein a mere string without a speck of mineral in it the whole way"; and in 1870, the shaft had been sunk "24 fathoms on a course termed a lode but having a very problematical appearance and not a grain of any kind of ore."

Ellan Vannin Mine.¹

Under this term an unproductive trial was made between 1870 and 1875 in the little glen, locally known as Cartwright's Glen, which joins Glen Auldyn south of Skyhill farm. The workings were commenced on the strength of the discovery of lumps of lead-ore in a gossany north-and-south vein in the bed of the stream, which it was thought might be the prolongation of the Laxey lode. The favourable indications disappeared however in adits driven north and south on the lode. A level was then driven from the bottom of the valley 200 yards lower down, below the bend of the stream, to cross-cut the lode under the hill. This is said to have attained a total length of 104 fathoms, with branches. Sir W. W. Smyth notes in his report for 1874 that the long level failed to show the least sign of any vein on which to open workings. A shorter level, 30 fathoms long, driven north-north-westward from the fork of the streams due S. of Skyhill, to test another supposed lode known as the Douk Vein, was equally unsuccessful. The cost of the trials must have been considerable, and no ore was marketed.

¹ From plans and information furnished by Mr. W. H. Rowe.

Glen Auldyn Lead Mine.¹

This name was given to a series of trials in the upper part of the picturesque glen which falls into Glen Auldyn from the east at Balleigh-eragh (six-inch, Sh. 5). The earlier workings in the ravine, 500 yards west of the mountain road below North Barrule, consisted of sinkings and short levels on a vein striking N. 20° E., with a westerly dip. A dyke of olivine-dolerite (described on p. 136) is intercepted by the supposed lode at this point, but I have not been able to obtain definite information as to their relationship. A deep adit-level was afterwards started 200 yards lower down the valley, to cross-cut the lode; and was driven 69 fathoms, but is said only to have cut the 'flookan,' a subsidiary vein, and not the main lode. Sir W. W. Smyth refers to the workings in his report for 1866, describing the vein as a "soft lode on which adits are driving . . . with small isolated stones of lead ore." No returns of ore were made.

In another branch of the same glen, 400 yards west of the above, at the place marked "Lead Mine" on the six-inch Ordnance map (Sh. 5), there is an old working regarding which no information is forthcoming; it appears to consist of a level driven south, but no lode is visible.

Glen Crammag.

An old adit may be seen in the east bank of this glen, 300 yards above its junction with the Sulby River (Sh. 7). It goes E. 20° N. on a dislocation at the margin of the "crush-conglomerate," the "lode" consisting of crushed slaty pyritous fault-stuff and quartz. This is probably the working mentioned by Smyth in his report for 1866 as being on a "very unpromising great dowk lode."

Glenfaba Trial.

Respecting the working on the south side of the Neb about 100 yards N. of Raggatt, Smyth reported in 1858, "a level has been driven a few fathoms from near where the road, at one mile south of Peel, crosses the river, but there is no lode at all."

Glen Meay or North Foxdale Mine.

A plan of metalliferous veins at 'Glen May,' dated 1826, is preserved in the Woods and Forests Office, showing two north and south "main veins," and three N.W.—S.E. "cross-veins" or "feeders," with the note—"The whole of these veins, ladders and feeders bear lead ore to the surface, and are in every way promising to be productive in that metal." The workings afterwards carried on, chiefly between 1857 and 1865, were situated 550 yards from the shore, or 150 yards higher up the glen than the position of the veins as shown on this plan which, however, may have been incorrect in scale.

In Sir W. W. Smyth's reports for 1858 and 1869 it is stated that small portions of ore were visible in the workings, but no appearance of a regular or strong vein. In 1861 we learn from the same source that drivings were being prosecuted "at 15 fathoms deep, in two lodes running pretty distinctly through clay slate and from 6 inches to 2½ feet in breadth, but unfortunately yielding no ore; traces of iron pyrites and carbonate of iron being all the metalliferous matter present." In 1865, "favourable stones of lead ore have been met with at various points, but not continuous enough to be of value." In 1866, a 14 fathom level had been driven a great many fathoms east to no purpose, as well as a cross-cut north; while "a short cross-cut south on the extreme west of the workings has laid open a very

¹ Information chiefly furnished by Mr. W. H. Rowe, to whom I am indebted for a copy of a mining plan of the locality.

promising appearance of lead ore, at the rate of several cwt. of ore to the fathom." In 1867, it is stated that in the last 3 fathoms of the shaft the vein had yielded stones of lead to make up 3 or 4 tons. In 1868, the workings are described as a 50-fathom inclined shaft, and a driving of 3 fathoms. In 1869, we learn that the 50-level had been driven 70 fathoms west and 30 fathoms east on an unkindly lode yielding nothing whatever; and his is the last mention of the mine in these reports.

Glen Rushen and Niarbyl (Isle of Man Antimony Mining Company).

In an old trial made about the middle of last century on the shores of Niarbyl Bay in search of the westward prolongation of the Foxdale lode, a small body of antimony ore (*antimonite*) was discovered. As it was currently believed that more of this ore might at that time have been obtained if it had been considered worth working, the ground was reopened in 1893-4 by an adit driven eastward into the cliff at Traie Vrish (Sh. 12), 400 yards S.E. of The Niarbyl, only to find that the ore-body had been merely a small pocket which had been entirely cut out in the previous workings.¹ Specimens of the ore may still be obtained from the old spoil heap at the foot of the cliff at this place. It is apparently the only occurrence of this mineral in the Island.

A renewed attempt was made under the same auspices to discover the Foxdale lode in Glen Rushen, west of Beckwith's Vein (p. 504), but without success.

Injebreck Mine.

Under this name a trial was made between 1872 and 1876 in the valley of the head-waters of the River Glass, 300 yards N.E. of Injebreck House, at the place marked *Lead Mine* on the six-inch Ordnance map (Sh. 10). Smyth described it in 1874 as consisting of a shaft 22 fathoms deep, with a bit of level east and a cross-cut south, revealing mere specks of ore of no value.

Kerroo-Mooar Mine.

This rather extensive mining trial was made between 1860 and 1870 in the steep bluff of slate at Kerroo Mooar, nearly a mile to the eastward of the village of Sulby. It consisted of three levels driven, one above the other, southward into the hillside on a somewhat uncertain 'lode' striking nearly due south with an easterly underlie. The lowest level was about 100 fathoms in length; the second 80 fathoms; and the highest 50 fathoms; the vertical distance between the first two being 16 fathoms, and between the last two, 10 fathoms. In the two upper levels a little galena and blende, associated with barytes, was discovered, but not in marketable quantity. The lowest level for several fathoms from its entrance was in the boulder clay, which is banked thickly against the foot of the slope. The workings intercepted one of the olivine-dolerite dykes, and a shallow sinking on the dyke is said to have revealed; a little galena on the 'foot-wall' of the intrusion.² In an adjacent open quarry, as described on p. 59, one of the older 'greenstone' intrusions is worked for road-metal, and a thin dyke of olivine-dolerite, probably a 'fier' from the dyke found in the mine, is seen to traverse both the country-rock and the 'greenstone.'

¹ Information supplied by Mr. Bawden, the manager of the recent workings.

² We are indebted to Mr. W. H. Rowe for most of this information.

Sir W. W. Smyth mentioned the operations in his report for 1866 as "a promising vein being driven on, but without farther discovery of ore," and in 1867 noted that "a good deal of veinstone containing lead and zinc ore has been brought to the surface, but none yet dressed."

Kirk Michael Lead Mine.

References to preliminary operations in this locality are contained in Sir W. W. Smyth's reports,¹ for the years 1858, 1859, 1860, and 1861, but the chief work on this small mine was effected at intervals between 1868 and 1883. Its total yield as given in "Mineral Statistics" between 1870 and 1883 was 222 tons of lead ore. It is situated in the deep glen which lies between Slieau Curn and Slieau Freoaghane, about $1\frac{1}{2}$ miles S.E. of Kirk Michael, and furnishes the only known example of a metalliferous vein in the north-western district of the Island. The direction of the lode seems to have been about W. 40° N.—E. 40° S., with a north-easterly underlie, but after being traced for 120 yards it was lost in both directions, apparently through cross-faulting, being intercepted by east to west slides, known respectively as "the Great Douk vein" on the S.E. and the "Cross lode" on the N.W. The mine was worked by three day-levels driven into the hill to intercept the lode, and by a shaft. Other trials were made on the steep slopes on both sides of the glen, but with no result.² In describing the workings on the productive part of the mine in his report for 1875, Smyth notes that in the No. 2 level, S. of the cross-cut, a shaft had been put down 6 fathoms, with drivings north and south from it, the lode 2 to 3 feet wide "consisting of two small strings of galena with killas between them, and yielding at most 8 or 10 cwt. of ore per fathom." We are informed that over £10,000 was expended on this property.

Laurel Bank and Wheal Michael.

In his report for 1863 Sir W. W. Smyth refers to a working of this name carried on by Mr. Ashe "in some singularly contorted 'country' in which were some irregular floors of quartz sparsely containing delicate stars of a rare nickel-mineral, 'Millerite,' but there was no lode at all." In his "List of Manx Minerals" (Isle of Man Nat. Hist. and Antiq. Soc., vol. i., p. 147) the same authority mentions the mineral as "delicate capillary crystal vein-stuff at a trial shaft at Rhenas, south of Kirk Michael." It is not easy to identify this locality; Laurel Bank is given on the 6-inch Ordnance map, Sh. 9, as the name of a house on the western side of the Neb Valley one mile below Glen Helen; Rhenas is two or three miles higher up the same valley just above Glen Helen. There are traces of a small mining trial between these places, 500 yards south-west of Lambfell Mooar, in the little gully which joins the Neb Valley just below Glen Helen; but Mr. Ashe's trials seem chiefly to have been carried on, under the title of the "WHEAL MICHAEL MINE," on the hill named Cronk ny Fedjag, about a mile north of Rhenas, where the traces of a shaft and other workings may still be seen. Either of these localities may be the place referred to by Smyth, but the former is the more probable. An old plan of the Wheal Michael sett in the possession of Mr. W. H. Rowe shows two supposed lodes; one coursing east-north-east, on which the shaft is sunk; and another, coursing north-north-east and intersecting the first, which was tested by a short level in Glion Cannell, 150 yards north of Shaghlaigquiggin. Both lodes are said to have yielded samples of lead ore. An older working, apparently of greater extent but respecting which no information is forthcoming, occurs a little farther east, on the banks of the stream 350 yards north of Cronkbane Farm, in the vicinity of a mass of intrusive "greenstone" (p. 137); this is marked "*Lead Mine (Disused)*," on the six-inch map (Sh. 6).

¹ MSS. in Woods and Forests Office.

² The above information has been furnished by Mr. W. H. Rowe.

Maughold Head Copper Mine.

This working, erroneously marked "*Lead Mine*" on the six-inch Ordnance map (Sh. 5), consists of an adit, stated to be 60 fathoms long, driven into the cliff on the south side of Gob ny Strona, the most easterly point of Maughold Head, on a dolomitic vein containing a little copper pyrites, striking in a west-north-westerly direction. Sir W. W. Smyth referred to it in his report for 1866 as "a lode 3 feet wide, promising in appearance, but in a place very difficult of access"; and in 1867 he mentioned that a shaft had been sunk for 10 fathoms at the base of the cliff, where the ore appeared to be cut out. The trial was abandoned without having produced any marketable ore. (Since this was written, work has been resumed here, the shaft deepened, and a level at 18 fms. driven towards low-water, where the lode is reported to widen out.)

Montpellier Mine.

This was a trial made about 1866 in the ravine of the western feeder of the Sulby River under Sharragh Bedn (Sh. 7) 600 yards N. of Croit. A line of disturbance and faulting traverses the slates in this glen in a W.N.W. direction, hading northward, which may have constituted the 'lode.' Some lumps of lead-ore are said to have been obtained, but nothing of permanent value; one of the levels is stated to have gone about 50 fathoms. Sir W. W. Smyth described it in his report for 1866 as "a level driven and shaft sinking with nothing to recommend it."

Mount Dalby Silver-Lead Mining Company, Ltd.

Under the auspices of this company some trials were made near Dalby about the year 1872 in the valley of the Lagg River, half a mile east of Barrane, but without attaining any useful result. Sir W. W. Smyth, in October 1872, after examining these workings, reported that "of the favourable appearances. . . not a trace exists," and that the only facts were that the sett contained vein-like traces, in which no ore had yet been found, in the direction of the Foxdale lode. The statements which were made in the prospectus of this company must be read with astonishment by anyone knowing the ground.

Onchan (Douglas Bay) Mine.

This working, which appears in the list of Manx Mines in "*Mineral Statistics*" for 1891 and the succeeding years, consists of a sump and an adit in a direction of N. 10°—20° W., in the slate cliff on the northern side of Douglas Bay, 200 yards west of Derby Castle. From an account published in the "*Transactions of the Manx Geological Society, Session 1891-92*" (reprinted from "*Mona's Herald*" newspaper, 6th January, 1892), it appears that "a piece of almost pure plumbago was found upon the shore within a very short distance of the place," and the working seems to have proved the presence of that mineral in the lode. In the same account it is stated that "the adit so far shows a lode containing quartz, lead, baryta and oxide of iron, though as yet only in moderate quantities." A later newspaper report announced that ore had been found containing several pennyweights of gold per ton, but the discovery does not appear as yet to have assumed any economic importance.

Pen (Beinn) y Phot or Sulby River Mine.

The insignificant trial thus named consisted of a level and shaft (marked on the 6-inch map, Sh. 7) on the west bank of the headwaters of the Sulby River, one mile S.W. of the summit of Snaefell. Considerable sums must have been expended on the erection of a large wheel and other surface works, the ruins of which are still conspicuous. Sir W. W. Smyth refers

to it in his report for 1866, as "on a north and south lode, dowky or with soft clay"; and in the following year mentions that it was started with fine plans, and then heart lost. In a later communication to the Woods and Forests Office (Sept., 1881), he remarks that no conclusive trial was ever made at this place.

The Ramsey or Northern Mine.

This trial, on which some thousands of pounds were expended, was made between 1866 and 1873, on a small north and south vein containing a little galena and blende, in the slate cliff at Gob Ago (Sh. 5) on the eastern side of Port e Myllin (*Puyllin* of revised Ordnance map). The first workings consisted of an adit driven for about 50 fathoms southward on the lode; a shaft was afterwards sunk (26 fathoms?) and a driving under the sea northward commenced, where it was expected the vein would intersect the course of the broad belt of felsitic igneous rock exposed in the cliff 500 yards farther eastward (see p. 124).¹ No further discovery of ore was made however, and the total quantity produced was too small to be worth marketing. Another old level, a few fathoms in length, exists in the eastern corner of Port e Myllin 200 yards west of the above.

Sir W. W. Smyth makes brief mention of this trial in several of his reports.² In 1866 he notes there was "nothing more met with than pretty strings 1 to 3 inches wide with good galena"; in 1867 he refers to it as "a tempting vein of lead ore, but far too small to be important." In 1871, the shaft had been sunk 21 fathoms and was intended to go 5 fathoms deeper; in 1872, a cross-cut was being driven out; and in 1874, the mine was "idle."

NOTES ON OTHER VEIN-PRODUCTS.

Gold.

From the general character of the Manx Slates and some of its veins, it is not inherently improbable that a little gold should be found in the Isle of Man; but the evidence for its presence is, as yet, scarcely satisfactory. In 1867 D. Forbes in describing the occurrence of polytelite in the Foxdale Mine mentioned that the Foxdale granite is identical in composition with some auriferous granites, and that traces of gold were reported to have been found in the gullies and in quartz-veins contiguous to it.³ Capt. J. Kitto, late of the Foxdale Mines, informed me that he also had heard that specimens of gold had been found, some time ago, in this district, but had not himself seen them.

Among Cumming's geological specimens preserved in King William's College at Castletown, are two water-worn fragments of slate showing specks of free gold, in the one specimen on a smooth cleavage face, and in the other in a crushed vein-streak. An almost illegible label on one of the specimens appears to read "Langness," and the rock is of the kind which occurs in that locality. The reported presence of gold in a vein mined on the northern side of Douglas Bay has been mentioned on p. 548⁴.

¹ From information and plan furnished by Mr. W. H. Rowe.

² MSS. in Woods and Forests Office.

³ "Researches in British Mineralogy." Phil. Mag., 4th ser., vol. xxxiv., p. 354.

⁴ A note of this supposed discovery appeared in "Nature" of Jan. 24th, 1895, vol. li., p. 299.

The metal is not included in Sir W. W. Smyth's published list of Manx Minerals.¹

Since the above was written a small trial has been made near the Cluggid in Sulby Glen on a vein reported to contain gold; and another trial at Maughold. Both are however now suspended. (Aug., 1902).

Molybdenite.

This mineral occurs as a thin incrustation on joint-faces of the Dhoon Granite in the quarry on the west side of the high-road, half a mile north of Dhoon Glen, where, according to Smyth, it was mistaken for lead ore.² It has not been observed elsewhere in the Island.

Plumbago.

The presence of graphitic slate at two or three localities in the Manx Slate Series has been noted in a previous chapter (p. 94 and p. 134). No workable deposit of the mineral has yet been found in the Island. In Sir W. W. Smyth's "List of Manx Minerals" (op. cit., p. 143) graphite is recorded as occurring "impure in the Snaefell Lode 100 and 130-fathom levels"; and in some handbooks of Mineralogy (*eg.*, that of Greg & Lettsom, 1858, p. 2), "Beary in the Isle of Man" is given as a locality for the mineral. Documents in the Woods and Forests Office throw light upon the last-mentioned reference. From these it appears that in 1852 leave was granted to the Rev. J. G. Cumming and Dr. T. Underwood to search for manganese and other minerals in the parish of German, east of the Neb and north of the Peel and Douglas highroad, and that "in the course of their searches they have discovered some plumbago, which they wish to have included in their licence," which was accordingly done. In February 1854, the resident Crown Agent reported that a day-level had been driven about 25 feet in this sett, with a side-cut to meet the opposite cheek of the vein; and that about 40 tons of raw stuff had been raised, but the samples were not sufficiently good in quality to command the attention of plumbago merchants and no sale had been effected; strings of copper had also been observed in the district. The site of this working appears to have been on the slope of Beary Mountain, but the exact locality has not been identified; Cumming no doubt refers to it in his "Guide to the Isle of Man" (1861, p. 27), where he states, "Plumbago has been discovered in Glen Helen."

The discovery of a piece of plumbago of good quality on the foreshore at Douglas, derived from a neighbouring lode, has already been mentioned (p. 548).

In connection with this subject the occurrence, under circumstances previously discussed, of a singular string of anthracite in the Laxey mines should not be forgotten (p. 520).

¹ Op. cit., p. 146.

² *Ibid.*

LIST OF SMALL MINING TRIALS NOT DESCRIBED IN THE
FOREGOING PAGES.¹

Sheet of 6 inch Ordnance Map.	Locality and Position.	Description of Working.
Sheet 4.	Hillside S. of Ballaugh, 400 yds. W. of <i>Corn Mill</i> ²	Small shaft
	Glen S.W. of Sulby, in gully 400 yds. N.E. of Earykellue	Short trial along fault
	Glen S.E. of Sulby, in bank of stream 600 yds. S.S.E. of Ballamanaugh.	Short adit going E. 15 N.
Sheet 5.	Steep slope 300 yds. S.E. of Glentramman East, marked <i>Lead Mine</i> on 6-inch map	Adit; stated to go 8 or 10 fathoms on an E.-W. "douk-lode"
	Near stream 700 yds. S.W. of Parkneakin	Small sinking on "douk-lode with spots of lead"
	Cliff 300 yds. W.N.W. of Port Lewaigue	Short adit
Sheet 7.	<i>Glen Shoggle</i> , 120 yds. S.E. of Nascoin	Adit into south bank of stream
	Stream 400 yds. E.S.E. of Stockfield	Adit into west bank (? part of <i>Wheal Michael</i> workings; see p. 547)
	W. slope of Sartfell, 900 yds. S.E. of Barrowgarroo Beg	Adit, marked " <i>Lead Mine</i> " on 6 inch map, but probably a slate-trial
	Head of <i>Glion Kiark</i> , S. of Slieau Freoaghane	Level in connection with slate-trial
Sheet 8.	Head of Glen Auldyn at slate-trials at upper fork of streams	Two levels (? for slate), marked on 6-inch map
	Head of Cornah Glen, between <i>North Laxey Mine</i> (p. 524) and <i>East Snaefell</i> trial (p. 526)	Adit in north bank marked on 6 inch map
	Cornah Glen, S. slope, 1,550 yds. W. of Corraney	Adit on hill-side marked on 6 inch map.
	Cornah Glen, S. slope, 1,100 yds. S.W. of Corraney	Adit near top of slope.
	Cornah Glen, in gully 150 yds. S. of Park Lewellyn	Short adit, E. 15 N.
	Cornah Glen, N. side of stream 200 yds. W. of Corraney	Adit 40 fathoms long, on a well-marked lode without ore
	Cornah Glen, S. slope, 250 yds. S.E. of Corraney	Small shaft; hematite-stained slate in spoil-heap
	E. bank of small stream, 250 yds. S.W. of Boileyvelt	Small shaft?; spoil-heap of hematite-stained slate

¹This list represents the old trials noted on the working map during the Survey, respecting which no information was forthcoming. It does not profess to be exhaustive, as there have no doubt been many other trials of which there are now no distinct traces. It is intended to illustrate the extent of the exploratory work.

²Distances given as measured on the 6-inch map; place-names in italics will be found on the 6-inch map, but not on the 1-inch.

Sheet of 6 inch Ordnance Map.	Locality and Position.	Description of Working.
Sheet 8 (cont.).	Ballasaig, 200 yds. W.S.W. of <i>Smithy</i> , and again 50 yds. N. of <i>Smithy</i>	Small shafts (trials for hematite)
	Ballagorra, 400 yds. W.S.W. of Chapel at cross-roads	Small shaft
	Ballagorra, 350 yds. N. of Chapel at cross-roads	Adit, "50 fathoms long" (see p. 541)
	Ballagorra, 250 yds. S.E. of Chapel at cross-roads	Small shaft (obliterated)
	Cliff 500 yards S.W. of Gob ny Garvain	Short adit N. 15. W.; marked <i>Iron Mine</i> on 6-inch map (see p. 127)
	Cliff at Bulgham Bay, 300 yards S. of Dhoon Mine adit (see p. 528)	Short adit
	Dhoon, in small ravines east of high road.	Several short adits in granite, for 'polishing powder' (see p. 556)
	Head of <i>Glen Ruy</i> (Glen Agneash)	Adit (and shaft?) marked <i>Lead Mine</i> on 6 inch map
	Glen Agneash	Several workings in search of N. prolongation of Laxey lode (see p. 523)
	Laxey Glen, east bank of <i>Stroan ny Fasnee</i> .	Adit N. 25 E.
	Laxey Glen, west bank, 150 yards above <i>Mill</i> .	Adit, starting in till
	Laxey Glen, lower part.	Several workings in search of S. prolongation of Laxey lode (see p. 521)
Sheet 9.	Cliff S. side of White Strand.	Adit along small fault in Peel Sandstone
	<i>Cass Stroan</i> , 150 yards inland.	Shaft in Peel Sandstone (see p. 274)
	N. corner of field 350 yards E.N.E. of Lambfell Moor.	Spoil heap, small sinking?
	Cliff 300 yards S. of Glen Meay.	Adit
	Gordon, 500 yards W. of high road.	Adit (and sinking?) marked <i>Lead Mine</i> on 6 inch map
	Ballacoshnahan, near W. margin of valley 700 yards S. of <i>Ash Lodge</i> .	? small sinking
	N. slope of Slieau Whuallian, 300 yds. S.W. of Glen Aspet	Small shaft
	N. slope of Slieau Whuallian, 300 yds. S.E. of Glen Aspet	Adit in connection with slate-trial
	Lower part of Foxdale, west bank, 550 yds. E. of Slieau Whuallian Farm	Adit S.W. through till into slate
	Lower part of Foxdale, in small gully, 400 yds. E.S.E. of Slieau Whuallian Farm	Adit: marked <i>Lead Mine</i> on 6-inch map.
	West side of road at Ballacates	Adit
	Slope 800 yds. N.N.E. of Ballagaraghan	Obscure spoil-heap? : graphite-trial? (see p. 550)

Sheet of 6 inch Ordnance Map.	Locality and Position.	Description of Working.
Sheet 10.	S. side of glen N. of Carn Gerjoil, in N.W. corner of field 200 yds. N. of mountain road	Obscure spoil-heap, probably adit
	Hillside S. of Greeba, 300 yds. W. of <i>Creg y Whualliam</i>	Spoil-heap : shaft or adit
	N. side of <i>Coollingill</i> , 500 yds. S. of <i>Creg y Whualliam</i>	Shaft (see p. 518)
Sheet 11.	N. branch of Glen Roy, 350 yds. E. of Ballaquine Cliff, 750 yds. S. of Laxey Harbour	Adit E. 30 N. into bank of stream Adit
	Cliff, 1,150 yds. S. of Laxey Harbour	Adit N. 10—20 W.
	Cliff, Garwick, on S. side of Glen	Adit, now called a cave
	Cliff, Garwick, 150 yds. S.E. of above	Adit, now called a cave
	<i>Glen Gawne</i> , Garwick, S. bank 350 yds. W. of shore	Adit and cross cut
	<i>Glen Gawne</i> , Garwick, S. bank 100 yds. W. of tram-line bridge	Adit S. 30 W.
Sheet 12.	Head of middle fork of glen east of Ballelby, near Dalby Cliff on S. side of <i>Gob ny Gameren</i>	Small trial (adit ?) Small trials
	<i>Ghionn Maarliagh</i> , 600 yds. E.N.E. of Ballavell, Glen Rushen.	Short adit
	Glen Rushen, W. side, in gullies 300 yds. N. of <i>Ghionn ny brack</i>	Short adits (see p. 546 for other workings)
	Glen Rushen, in banks N. of high-road bridge	Short adits
	500 yds. N.W. of South Bar-rule Quarries	Adit in connection with slate-trial
	<i>Beal-feayn-ny-Geay</i> , S.W. side of Cronk ny Arrey Lhaa	Adits along faults
	Summit of Cronk Fedjag	Adits in connection with slate-trials
	Gully 250 yds. N.E. of Garey Moor	Adit along decomposed olivine-dolerite dyke (see p. 556)
	Mooney Moor, in <i>Ghion Cam</i> , 200 and 250 yds. below high road	Two adits, one in each bank, respectively N. 30 E. and W. 35 S.
	S.W. of Granite Mtn., 300 yds. E. of head of <i>Struan Bar-rule</i>	Spoil heaps of slate ; ? small sinking
Sheet 13.	Corner of field 300 yds. S. of Ellerslie farm	Shaft
	Hillside 500 yds. S.S.E. of Ballingan	Adit
	West bank of Santon River, on S. side of road 350 yds. N. of Ballacorris	Small shaft

Sheet of 6 inch Ordnance Map.	Locality and Position.	Description of Working.
Sheet 13 (cont.).	East bank of stream at <i>Ballalough</i> , 200 yards S.E. of highroad bridge east of Richmond hill	Small excavation: trial?
	Cliff at Fiddler's Green 700 yards S.W. of Douglas Head	Adit (see p. 544)
Sheet 14.	Cliff at <i>Stack Indigo</i> , 600 yards S. W. of last	Adit, obliterated; marked <i>Lead Mine</i> on 6 inch map
	Cliff on E. side of Onchan Harbour	Short adit; marked <i>Lead Mine</i> on 6 inch map
Sheet 15.	Cliff on E. side of <i>Port Jack</i> , 600 yards S.W. of last	Adit, obliterated; marked <i>Lead Mine</i> on 6 inch map
	Cliff in <i>Ghaw Dhoo</i> on N. side of Bradda Hill	Adit.
	Cliff 150 yards W. of last	Adit? near olivine-dolerite dyke (see p. 171)
	Hillside 300 yards W. of "West Bradda trial" (see p. 537).	Small trial
Sheet 16.	Head of Colby River 300 yards W.S.W. of Ballacannell	Adit in E. bank
	West bank of Silverburn, 150 yards S. of <i>Oregg Mill</i>	Adit (see p. 197)
Sheet 17.	Cliff at <i>Traie ny Gill</i> , 300 yds. W. of Port Greenaugh	Adit
Sheet 18.	Cliff in recess W. of Baroo Ned	Adit (see p. 532)
	Cliff at <i>Rheboeg</i> , Bay Stacka	Adits, marked <i>Mine</i> on 6 inch map
Sheet 19.	Cliff on E. side of Langness, N. of <i>Tarrastack Rock</i>	Two short adits, 40 yds. apart; (for trials on W. side of Langness see p. 538.)

CHAPTER XIII

NON-METALLIC PRODUCTS.

Umber and Ochre.	Roofing Slate.
Rottenstone.	Building Stone.
Fuller's Earth.	Road-material.
"Dun Earth" or "Asbestos."	Lime.
Vein-Quartz.	Bricks.
Coal Trials.	Sand and Gravel.
Salt.	
Peat.	

Umber and Ochre.

The production of these colouring earths in small quantity in the Isle of Man dates back at least from the beginning of the nineteenth century. Macculloch, in 1819, mentions that "yellow ochre has been found in sufficient quantity in some of the mineral veins, to have become at one time a matter of export," but that the mines had long since ceased to be wrought.¹ The mines referred to were probably Bradda and Ballacorkish, as Smyth notes the occurrence of the substance in these lodes.² In the documents relating to the transfer of the mineral rights of the Island to the Crown in 1827-8, Mallev is the only locality given for Yellow Ochre; at the same time a report of the Crown Agent states that "of this ocker there is great abundance in the Island of excellent quality" but that the lessee had failed to make it pay. From the somewhat incomplete returns given in "Mineral Statistics," as shown in the Tables at pp. 496-8, the production since 1858 seems usually to have ranged between 100 and 200 tons per annum.

The substance has been obtained from two distinct sources. One variety, prepared in the village of Ballasalla, is derived from the decomposed black flaggy Carboniferous Limestone (Castletown or Lower Limestone), which is often weathered at the surface and along irregular pipes and veins into brown earth, as may be seen in the cliffs north of Ronaldsway and in the large quarries west of Ballasalla. This change is especially noticeable where the limestone is dolomitised.³ During our survey of the district the principal supply was being obtained from shallow pits in the little outlier of Carboniferous rocks east of the fault near Athol Bridge, one mile N.N.W. of Ballasalla, at the place

¹ "Western Isles," vol. ii., p. 579.

² "List of Manx Minerals." Isle of Man Nat. Hist. and Antiq. Soc., vol. i., p. 145.

³ Similar decomposition of dolomitic limestone into umber in Devonshire has been described by R. J. Frecheville in a paper on "The Umber Deposits at Ashburton." Trans. Geol. Soc. Cornwall, vol. x. (1884), p. 217.

marked U on the geological map. The 6-inch Ordnance map (Sh. 16) shows an "*umber pit*" near the boundary of the limestone at Billown, 600 yards west of the Ballahot quarries, but this is no longer worked and the section is obliterated. In preparing the substance, the raw material is pounded, washed and run into settling tanks in which the umber remains as a fine paste and is then dried and ground.

The other source of the material is from decomposed olivine-dolerite dykes and from rotten ferriferous slate adjoining veins, and sometimes apparently from the ferruginous portion of the vein-stuff itself. Near the surface, both the dyke and the country-rock, as well as the vein, are occasionally perished to a brown earth which furnishes the umber. The chief supply of this variety has of late years been drawn from the day-level in the cliff on the southern side of Maughold Head, mentioned on p. 126, which follows the course of an olivine-dolerite dyke that intersects the Drynane hematite-vein. This is known as the Baldroma Mine, and was last in operation between 1887 and 1893. In the upper part of the Silverburn basin, in a gully 250 yards S.W. of Garey Mooar, there is a similarly decomposed dolerite dyke, along which a short level has been driven, but whether for umber or in search of other ores has not been ascertained.

Rotten-Stone.

At the umber works at Ballasalla a small quantity of 'rotten-stone,' for use as a polishing agent, has also been prepared, the raw material being a fine argillaceous silt, which has accumulated, apparently by rain-wash, in a boggy depression on the moorland between South Barrule and Cronk Fedjag. Though used for the same purpose, this is, of course, an entirely different substance from the 'dun-earth' described below.

Fuller's Earth.

Information regarding the fine glacial clay which has been dug for this purpose in Glen Wyllin near Kirk Michael will be found in Chap. XI., pp. 428 and 447.

'Dun Earth' or 'Asbestos.'

The 'Asbestos' (fibrous tourmaline) which occurs in veins in the Dhoon Granite under conditions described in a previous chapter (p. 143) was mined for a time to a small extent, as a polishing powder, early in the past century. The material was mentioned by Woods, in 1811, as being in local use;¹ and Henslow, in 1821, described it as follows:—"Fibrous Actinolite occurs in a decomposing state near the Dun, in two veins, each about six inches broad, traversing the decomposed portion of the

¹ "An Account, etc., of the Isle of Man," p. 17.

granite and gneiss. It is accompanied by quartz, which it penetrates and frequently colours. It may be taken from the vein in fibrous bundles of three or four inches in length, but it is in general so much decomposed as to have assumed an earthy form. . . . On pressing the fibres between the fingers they crumble to a harsh powder capable of taking away the polish from glass, and consequently very unfit to be used in cleaning plate, a purpose to which it has been applied. I found a single specimen in which the fibres were flexible. Specific gravity = 3.03."¹

A plan of the workings, dated 1826, is preserved at the Woods and Forests Office, showing three short levels, one on the northern and two on the southern side of the stream, with a note in reference to the northern level that "the mineral substance called Asbestos or polishing powder disappears at the end of the workings." A lease had been granted by the Duke of Athol for the mining of this substance, but the Crown Agent in reporting on it in 1827-8 remarks, "Mr. S—— wrought this for a short period and paid 15 guin^s of Lordship, but he abandoned the work some years ago, but whether from its being unprofitable or for other reason, I know not."²

Vein-Quartz.

The broad vein of this substance quarried on the N.E. side of the Foxdale Granite has been described on p. 166. It has been exported on a small scale; and is in favour locally for ornamental rock-work. A smaller quarry has been opened in a similar vein on the north slope of Kerrowgarroo, $\frac{1}{2}$ mile E. of Kennaa, near St. Johns (p. 164). The material occurs in strings and lenticular masses in every part of the Manx Slates, especially in the Barrule Slates (p. 320), but is generally more or less entangled with the country-rock and intermixed with small quantities of mica, chlorite, pyrites, etc.

Coal Trials.

The search for coal in the Island has been long and obstinate, and as yet fruitless. The earlier trials were foredoomed to failure, being for the most part ignorantly carried on in rocks older than the Coal-measures; while the later researches in the north, beneath the drift-covered plain, where alone some possibility of success existed, have, up to the present time, failed in their main object; though they have revealed a small salt-field which may prove of economic importance.

As previously noted (p. 481), we learn that, as far back as 1669, the ruling Lord of Man (Charles, 8th Earl of Derby) "being by good reasons persuaded that there is plenty of coales" in the

¹ Trans. Geol. Soc., vol. v., p. 498.

² MSS. Athol papers in Woods and Forests Office.

Island, ordered a search to be instituted; and Bishop Wilson, early in the 18th century, referred to several unsuccessful attempts having been made to find them.

Dr. Berger discussed the subject at some length in his memoir published in 1814, and gives reference to some older records in Curwen's "Agricultural Report" (Workington, 1810). He says:—"While I was in the Isle (June, 1811), two or three spots in the north-western part were particularly pointed out to me as places where coals did *actually* appear, or were *cropping out*. But when the matter was strictly enquired, the reports turned out unfounded. . . . The only serious attempt, I believe, to find coals in the Isle was made at Derbyhaven [in Carboniferous Limestone] many years ago by a speculator from Cumberland. After having gone to a certain depth, not finding traces of them, he gave up the search as fruitless."¹ Macculloch, in 1819, mentions, but discredits, the report that coal had been found in the red sandstone near Peel; and he adds that since his visit to the Island he had received fragments of coal said "to have been found under the limestone or in the conglomerate of Derbyhaven where some expensive borings for that purpose were formerly made."²

It was no doubt the same supposed discovery which was referred to in the following terms in the "Manx Mercury" of 26th Nov., 1793³:—"We feel unspeakable pleasure in being able to announce to our readers that a stratum or bed of coal has been discovered near Derbyhaven in this Island, at a depth of about 60 feet from the surface of the earth." This statement was of course unfounded, but is still remembered and repeated in the locality.

From documents preserved in the Office of Woods and Forests it appears that the search was still fitfully continued during the first half of the present century. The resident Crown Agent, in reporting on the matter in 1836, says, "Many trials have been made and considerable sums expended, but always without success," and refers also to his "knowledge of many unsuccessful trials made by the late Duke [of Athol] to find coal." About this time a licence to search for coal was granted to E. Forbes, of Douglas (father of Professor Ed. Forbes)⁴ and others; and it is mentioned that trials had previously from time to time been permitted on the Waste Lands (of The Ayre?), but without result. In a "report of the Directors of the Isle of Man Coal Company," dated 22nd February, 1840 (quoted in the prospectus of a later company,) the following details of a boring at Ballasalla

¹ Trans. Geol. Soc., vol. ii., p. 56.

² "Western Isles," vol. ii., p. 574.

³ Quoted in the Prospectus of the "Isle of Man Coal Co., Ltd." (about the year 1870).

⁴ In an article on Manx Geology contributed by Prof. E. Forbes to Quiggin's "Guide to the Isle of Man," it is stated that in several places, both in the limestone and slate, specimens of anthracite or blind-coal occur, and that these had been mistaken for bituminous coal and led to useless researches (p. 56; 4th ed., 1852).

are given :—"The measures gone through at Ballasalla are, first, 7 yards white sandstone; secondly, 24 yards of layers of limestone, varied from 2 to 7 feet thick, with intermediate layers of soft blue clay; thirdly, 23 yards of old red sandstone in layers from 3 to 12 yards in thickness, with three layers of clay; fourthly, 5 yards ferruginous bands." It is stated that these explorations "abandoned for a time for the purpose of searching at the north of the Island, were intended to be resumed, but in consequence of the Company breaking and losing the boring rods, they declined to further prosecute the work." The top "sandstone" is probably drift, the lower beds being, of course, the Carboniferous Limestone and its Basement Conglomerate (see p. 196). The northern boring alluded to was probably that made at the Craig near St. Jude's Church in 1839, described by Cumming in a passage quoted on p. 280. A document in the Woods and Forests Office, dated 18th February, 1843, mentions that upwards of £1,000 had been spent in this search, which had been suspended two years previously.

Another company, with the title of "The Isle of Man Coal Company, Limited," the prospectus of which has been quoted above, was organised about thirty years ago to make further search for anthracite coal in the neighbourhood of Ballasalla and Derbyhaven, but no information is forthcoming as to its actual operations. In 1873 renewed explorations were also set afoot in the Peel district. All that could be learnt respecting these and the earlier trials in the same neighbourhood has already been stated (Chap. VI, pp. 278-9). The systematic and thorough investigation in the extreme north of the Island commenced by Messrs. Craine Bros. of Liverpool in 1891, and still in progress, has been fully discussed in a preceding chapter (Chap. VII., pp. 280-95).

Salt.

Steps are being taken to make economic use of the salt deposits discovered in Triassic Marls of the Point of Ayre borings, described on p. 289. It is proposed to pump the brine and convey it in pipes to Ramsey for treatment. In "Mineral Statistics" for 1895, p. 101, a return of 10 tons from this source is recorded—the first in the annals of the Island.

Peat.

Information regarding the distribution of peat and the places where it has been dug in the Island has been given in a foregoing chapter (pp. 415-6).

Roofing Slate.

Reference has previously been made (Chap. III., p. 50), to the many costly attempts to find roofing slate in the Island and to the uniform ill-success which has attended them. The unsuit-

able character of the cleavage and flow-structures (p. 73), as well as the prevalence of shear-planes and quartz-veins, and their combined detrimental effect upon the hardness and compactness of the slate-rocks sufficiently explain the failure of these attempts, and in most cases ought to have been a deterrent before the loss was incurred. These trials have been chiefly made in the Barrule Slates, but a few have taken place in slaty bands in the Niarbyl and Lonan Flags. In the aggregate probably not far short of £100,000 has been expended in this manner in the Island with scarcely any return.

Bishop Wilson in the middle of the 18th century referred to blue thin light slate as a matter of export¹; and Berger, in 1814, mentioned roofing slate as being obtained at Peel Hill and Ballagawne.² The oldest of the systematic trials is probably that at the northern end of the ridge of South Barrule, which is included in the schedule of the property transferred from the Duke of Athol to the Crown in 1827-8. At that time the slate-quarries of the Island were under lease to Mr. Knott; but from the report of the Crown Agent it appears that the tenant had met with opposition from the natives "who at their own hand and without the authority or licence of the lord had been accustomed to work the same."³ This custom is referred to by Cumming, who states:—"By the insular laws every person standing in need of limestone or building stone may enter on his neighbour's land and dig and carry away what is requisite for his own use, paying the occupier a reasonable satisfaction, which appears to be interpreted merely surface damage."⁴

Between 1860 and 1870 a very large amount of development work was done upon the South Barrule quarry; and about the same period more or less extensive openings were made, among other places, at the north side of Maughold Head near Port e Myllin (p. 124); at the head of Ballure Glen, south of Ramsey (p. 136); at several spots in Glen Auldyn; in Sulby Glen near the mouth of the Block Eary tributary (p. 133); in Glion Kiark on the northern slope of Sartfell (p. 138); in the valley of the Neb near the mouth of Glen Helen and lower down opposite Ballig (p. 157); on the coastward side of the hill south of Peel (p. 147); on the northern slope of Slieau Whuallian near Glenaspert; on the western side of Foxdale near Ballageay (p. 162); in the West Baldwin valley west of Awhallan (p. 157); on the western side of Greeba Mountain; on the east coast, at Bulgham Bay and a few other places; in Glen Rushen above Glen Meay (p. 163); and on Cronk Fedjag (p. 164). Numerous other localities where work was done on a smaller scale are mentioned among the topographical details in Chap. IV. The workings were mostly open quarries, but in a few cases shafts were sunk and galleries driven. Some produced a small quantity of slates, of inferior

¹ "History of the Isle of Man" (Cruttwell's ed. of 1786), p. 343.

² Trans. Geol. Soc., vol. ii., p. 38.

³ MSS. in Woods and Forests Office.

⁴ "Isle of Man," p. 311.

quality and in no instance good enough to compete with Welsh slates; the best seem to have been obtained from a narrow slaty band in the Niarbyl Flags south of Peel (see p. 147). For many years all these trials were abandoned, but work was resumed recently for a short time at the South Barrule quarry.

Sir W. W. Smyth's official reports contain many references to these quarries during the years of their activity, and as some of the workings are now filled with water or otherwise inaccessible, a few notes from this source may prove useful. In 1862, after describing several of the quarries, he remarks that he had seen no slate as yet opened in the Island good enough for exportation. In 1863, he notes that 120 men were at work in Glen Rushen on rock of a lamentably poor character; that South Barrule had some rather better slate; and that at Baldwin, where twenty men were employed, there was no rock at all like slate. In 1864, at South Barrule, with forty-five men, a fair quantity of material had been raised, and met with a ready local sale but was not good enough for an export trade. In 1865, the most effective trial was being made at Ballamoar [near St. John's] by sinking a shaft; and in the following year it is noted that at this place a tunnel had been driven a long way into the hill, finding throughout the same even-splitting slate, too soft to be applicable; in the same year, workings at Peel, Sartfell, Sulby Glen, Glen Auldyn and Maughold are also mentioned. In 1867, Smyth remarks that speculation had greatly cooled; that at Maughold some slate had been got, but with too much waste; at Glen Auldyn the lower gallery might do for local consumption; and at South Barrule it was too clear that the middle part of the quarry was too bad to touch, and the north and south ends, which were better, must be worked into the mountain independently, and some good piles of second-class slate had been got from the north end. In the following year we read:—"I regret to record the almost total collapse of this branch of industry, buoyed up as it has been chiefly by ignorant hopes on one side and false representations on the other." Two or three quarries however were still carried on, including that of Rhenass (Neb valley), the rock of which is described in subsequent reports as coarse and full of quartz, fit only for rough local purposes; and that in the Sulby valley, regarding which it is noted in 1871 that better stone had been found in a cut 8 yards below the chief floor, "but there is much spar all through the quarry still, and the cleavage is so imperfect that the product would certainly not be saleable in England or Wales"; 95 men were employed in this quarry in 1873, but it seems to have been abandoned two years later. The report for 1876 describes a spirited trial near Peel, where twenty men had been at work on a vein, only 32 feet wide, narrowing inshore and with a high cliff above, which rendered difficult any system of economic extraction; "several cargoes amounting to perhaps 100,000 slates have been sent away," but the enterprise was to be abandoned. In 1877, two or three men were at work at South Barrule only, and in 1880 no work was being done, "not even on South Barrule."

Building Stone.

Quarry-stone is the common building-material in the Island, and is usually obtained from whatever source is nearest, whether Manx Slate Series, Peel Sandstone, or Carboniferous Limestone, while in the drift-plain of the north glacial boulders are largely used.¹

¹ For special purposes, and for the more elaborate buildings, stone is occasionally imported from the mainland: Wood's notes (op. cit., p. 22) that the old Douglas Pier was built of stone from Runcorn, and Mona Castle of sandstone from Arran.

Manx Slate Series.

From the large area which they occupy, the Manx Slates furnish by far the greater proportion of the ordinary building stone, but the quality is inferior. It was adequately described long ago by Bishop Wilson as a "broken ragstone sometimes rising in coarse uneven flags, or in irregular lumps," which "an English mason would not know how to handle, or would call their walls, as one merrily did, 'a causey reared up upon an edge.'"¹ The material cannot be dressed, except very roughly, and is quarried in irregular slabs along whatever happens to be the dominant fracture-plane,—usually the bedding where the rock is somewhat arenaceous, and the shear-cleavage planes where it is argillaceous. The stone is best where the two structures are approximately parallel, but even then there is usually a cross-cleavage or close-jointing oblique to the dominant structure, which causes irregular acutely-angled edges to the blocks. All varieties of the slate-series are used, even including the crush-conglomerate (near Ramsey, p. 66), but the best stone is obtained from the Lonan and Niarbyl Flags and from some of the laminated passage-beds, while the quartz-veined grits are least in favour and are generally set aside for road-metal. In the north-western corner of the massif, north of Glen Wyllin and west of Glen Dhoo, and in a few other more limited tracts, the rock breaks up into faggot-like pieces along the intersecting structural planes (p. 131) and is of little use. In most buildings of rough slate, brick or dressed stone is employed at the angles and around doorways, windows, etc. On St. Michael's Island, Langness, the well-preserved walls of a fort built in 1650 contain many blocks of a schistose greenstone dyke which crops out in the vicinity (p. 181); and this stone, in spite of the exposed situation, has withstood the weather remarkably well—even better than the accompanying slate, which is itself very enduring.

A variety of the slate-rock which was formerly quarried, as described at p. 174, both on the crest and at the foot of Spanish Head was especially valued for its quality of raising in very tough and strong beams, somewhat flexible, and up to 15 or 16 feet in length, which were used for lintels, gate-posts, foot-bridges (p. 132), etc., and in Castle Rushen for flooring (p. 174). As previously mentioned, Macculloch states that a beam of this material 15 feet long and 2 inches thick was forced 5 inches out of the straight line before it broke. The top quarry seems to have been in working as late as 1858 (see "Mineral Statistics" for 1858, pt. ii., p. 269). The slate is of the banded argillaceous type, and its peculiar quality seems to have arisen from the compression of the rock in the trough of a fold, with the resultant intersection of flattish bedding by steeply inclined shear-cleavage. Under similar circumstances, in a quarry on the steep slope between Ballaugh and Gob y Volley, beams of the same kind of

¹ Bishop T. Wilson's "Description of the Isle of Man (Camden's Britannia ed., 1772), p. 392.

stone up to 24 feet in length have been raised, as described on p. 132; and probably these conditions might be likewise found in other places more accessible than Spanish Head. Though not at present worked, the material seems well fitted for various economic uses if it could be got at a reasonable cost.¹

The building-stone quarries in the Slate Series are usually small, being opened as occasion requires, near the place where the material is needed. At Douglas, however, there are large quarries (in the Lonan Flags) on the southern side of the harbour and near the northern extremity of the Bay (p. 153); and openings in the hill-side south of Ramsey have also attained a considerable size. From the quarries working under the Quarries Act and giving returns to the Home Office, the output for 1897 (Mineral Statistics, p. 140) is stated to have been 17,560 tons of the value of £1,056; in 1898 (*ibid.*, p. 248), 21,508 tons, value £1,282; in 1899 (*ibid.*, p. 256), 19,005 tons, value £1,057; and in 1900, 13,524 tons, value £754.

Peel Sandstone.

This red sandstone, being the only 'freestone' available in the Island, has been extensively quarried at Creg Malin and Ballaquane, north of Peel. The characters of the formation have been fully described in Chapter VI., p. 263. Only a small part furnishes building stone, the thin and irregular bedding and the shaly and conglomeratic intercalations being detrimental in the greater portion. The stone is only moderately durable, as may be seen from the condition of part of the ruins at Peel Castle on St. Patrick's Island. The output for 1897 ("Mineral Statistics," p. 140) is given as 2,800 tons of the value of £166; for 1898, 1,240 tons, value £76; for 1899, 1,827 tons, value £112; and for 1900, 1,218 tons, value £101.

Carboniferous Limestone.

Besides affording the chief source of lime for the whole Island and being to some extent used for road-mending, the dark grey flaggy Lower or Castletown Limestone of the southern basin supplies the local building stone, both dressed and in the rough. For the last-mentioned purpose, when carefully selected it is structurally well adapted, though somewhat dingy in colour; the excellent state of preservation of Castle Rushen at Castletown bears testimony to the durable quality of this stone. The principal quarries at present working are those at Ballahot and Billown, three-quarters of a mile W. of Ballasalla (p. 206), and that near Scarlet on the W. side of Castletown Bay (p. 203). The output given in "Mineral Statistics" for 1898 (p. 230) is

¹ Berger (op. cit., p. 37) and Macculloch (op. cit., p. 532) also mention among the economic products of the Island a "hone slate" occurring "at a place called Montpellier." The latter author describes the stone as "of a whitish colour and soft texture better adapted for the polishing of metallic plates than the uses of the cutler. It has not been exported." This stone is no longer in use, and I have failed to identify the locality referred to.

12,372 tons, value £2,813; for 1899 (*ibid.*, p. 238), 9,272 tons, value £881; and for 1900, 9,315 tons, value £895.

The so-called 'black marble' of Poolvash was obtained from the harder courses in the black flaggy and shaly "Posidonomya Beds" on the eastern shore of Poyll Vaaish, as described on p. 224, but is not at present worked. The best stone seems to have been found immediately underlying the volcanic ash, where the rock has been indurated, probably by a slight over-thrust of the Volcanic Series (p. 224). Among other uses, it was wrought into chimney-pieces, tombstones and steps. Being too soft to take a natural polish, it was covered with a kind of black varnish, and in this way objects wrought out of it were "made to look not much inferior to the best Derbyshire black marble."¹ The tombstones made from it show rapid weathering. The "steps of St. Paul's Cathedral in London," so often mentioned in Manx topographical literature as having been supplied from this locality, seem to be no longer in existence (p. 220). The total extent of the 'black marble' quarrying has not been great.

Granite.

In the district S. and S.W. of the Foxdale Granite, where glacially transported boulders of this rock are numerous, they have been largely used in building, but have shown themselves subject to very unequal weathering. A quarry was opened some years ago on the northern slope of the granite outcrop, but was not worked to any great extent; the operations have however been recently resumed. The rock is massive and not too hard, but is somewhat liable to crumble after exposure. The granite was formerly raised in long beams and shaped into rollers for agricultural purposes, and it is worth mentioning that fragments of these broken rollers may readily be mistaken for boulders in parts of the island when there are no true boulders of this rock.

The Dhoon Granite, being much harder and closer in texture, has been quarried for road-mending and for making paving setts; the latter industry was revived recently on an extensive scale for a short time, but has now again flagged. The following note respecting the quality of the granite is quoted from the *Journal of the Isle of Man Nat. Hist. and Antiq. Soc.* for 1898 (Yn Lioar Manninagh, vol. iii, pt. x, p. 488). "The granite of the Dhoon has been tested for road setts and other purposes. The results under compression, such as percussion and attrition tests, show that it is a most excellent stone for all road purposes, and most durable as a building stone. If basalt average 6 or 7.2, Dhoon is 7.3: Aberdeen granite . . . showing . . much . . below Dhoon."

The Oatland Granitite is at present used only for road material, for which purpose it is extensively quarried.

¹ Cunningham, "Isle of Man," p. 132.

Boulders.

In the northern drift-plain the absence of solid rock has led to the extensive use of glacial boulders both for road-mending and building. For the latter purpose the chief rock is the abundant Criffel Granite, the larger blocks of which are blasted into pieces and trimmed into shape; a good example of its use may be seen in Bride Church. Besides those found inland, large numbers of boulders are obtained from the shore, where they accumulate from the waste of the cliffs. Some have done duty over and over again in successive buildings, and the walls of old cottages in this tract are often interesting to the glacialist from the medley which they exhibit; but there is a striking rarity of limestone, this rock having been set aside for burning into lime.

In parts of the Island where the drift contains only ocal blocks these are sometimes also put to economic use.

Road Material.

Though subject to a brisk stream of carriage and waggonette traffic in the summer-time, the Manx high-roads are not often called on to bear heavy crushing loads, the vehicles used in agriculture being chiefly one- or two-horse carts and not heavy waggons. Consequently good results are obtained from stone of a quality unsuitable for more ponderous traffic, and a supply is usually got without much difficulty from a local source. Among the rocks thus laid under contribution are the quartz-veined grits and other hard beds of the Manx Slate Series, the Carboniferous Limestone, the Dhoon Granite and the Oatland Granitite. But the toughest and best material is furnished by some of the dykes, especially those of the 'newer greenstone' type (p. 297), intrusive into the Manx Slates: the only drawback being that these are usually narrow and discontinuous, and sometimes spoilt by shearing. These dykes, locally known as 'pot-metal,' have been quarried on a small scale here and there all over the slate area (for details see Chap. IV.); and at Poortown, 1½ miles east of Peel, a coarsely porphyritic boss of diabase is extensively worked (see p. 156). As a general rule the dykes lettered D and B^p on the map are, where thick enough, suitable for road-metal unless deeply decomposed; while those lettered B^a are usually too much altered by shearing to afford durable material.

At Crosby a broad dyke of microgranite of the Foxdale type furnishes much road-material of fair quality (p. 168). Accessible exposures of this kind of dyke-rock also occur in the West Baldwin valley (p. 158); at the side of the road between Foxdale and Castletown (p. 167); and at other places shown on the map; but have not yet been tested. These elvans, like the older 'greenstones,' are, however, sometimes spoilt by the platy structure developed by earth-movement.

The dykes associated with the Dhoon Granite (pp. 144-6) have not been quarried in the interior, as their chief outcrops are rather

inaccessible, but would probably supply material as good or better than the Foxdale elvans. The use of the granite itself for paving setts has already been mentioned.

Another dyke-rock which though not hitherto tested would probably yield tough and durable stone, is the mica-diorite of Port Groulle (p. 152); this could be conveniently excavated at its outcrop on the north side of Banks Hove; it occurs in a district where there is a comparative dearth of suitable stone.

The olivine-dolerites even where not too small are usually too much decomposed to be serviceable.

Boulders and gravel from the beach are made use of in many places near the coast, especially in the north of the Island where drift-material of this kind affords the only local supply.

Lime.

At present lime is prepared only in the Carboniferous Limestone tract of the south of the Island; but it was formerly burnt locally from a cornstone band in the Peel Sandstone near The Stack (p. 275); and at many places, especially in the north, from glacially-transported limestone boulders collected on the shore, the ruins of old kilns which one finds in unlikely places having generally been thus supplied. Berger, who quotes statistics showing that 84,992 barrels of lime had been sold from kilns in the south-eastern part of the island between the years 1807 and 1811, mentions that the northern farmers preferred the lime from the boulders to that from the southern limestone for manuring the land. The Manx Slates are essentially non-calcareous, the only portion possessing more than a mere trace of lime being certain fine-grained bands in the Niarbyl Flags, which contain up to 4·4 per cent. (p. 36), and a few sparingly calcareous nodules in the Lonan Flags (p. 34). The ruins of the ancient chapel on St. Michael's Island, Langness, show a very enduring mortar prepared from burnt sea-shells.

Brickearth.

At the time of the Survey, brick-making was being carried on only at three places in the Island—one in the N., on a very limited scale, at Regaby Beg (section described on p. 437); one in the W., in the valley of the Neb at Peel (described on p. 457); and one in the E., at Highton, one mile W. of Douglas (p. 455). The material in the first is weathered red boulder-clay; in the second, decomposed slate; and in the third, mixed slaty drift.

Disused brick-yards were noticed at West Craig, near St. Judes (p. 437); at Ballacoarey, $1\frac{1}{4}$ miles E.S.E. of Andreas; near Ballakelly, 1 mile W.N.W. of Andreas; at the northern end of the Mooragh at Ramsey; and at Port Lewaigue, 1 mile S. of Ramsey (p. 443), all in red boulder-clay: at Ballawyllin, a mile W. of St. Johns, in similar material (p. 458); and in the valley of the Neb,

nearly a mile north of St. Johns, in slaty till (p. 453). Except near the surface, where it has been thoroughly leached, the red boulder-clay appears to contain too much lime to make good bricks. The decomposed slate used at Peel furnishes a dense hard brick of a dullish colour. The operations in the Neb valley N. of St. Johns proved a costly failure, but whether from the nature of the material or from want of care in burning is not apparent.

In "Mineral Statistics" the Manx output of clay for brick for 1895 is given as 6,793 tons, value £339; for 1896 6,000 tons, £275; for 1897, 8,914 tons, £360; for 1898, 10,100 tons, £460; for 1899, 7,000 tons, £175; and for 1900, 8,000 tons, £500.

Sand and Gravel.

These materials are obtained from the glacial deposits of the extra-insular type (p. 335) on the flanks of the Island, where they are abundant, but are not found of serviceable quality where the drifts are entirely of the local type.

CHAPTER XIV.

AGRICULTURAL GEOLOGY AND WATER SUPPLY.

Soils, etc.

The glacial deposits are the chief factors in determining the character of the soil in the cultivated portions of the Island, as the principal tracts of solid rock occur on the mountains above the limits of cultivation. The northern plain, which constitutes the largest area of fertile land, exhibits the variability commonly found wherever drift has accumulated thickly, ranging from stiff clay to light sand and gravel, with peaty patches in the hollows. In this case, however, the boulder-clay rarely forms the stiffest soil, having a sufficient admixture of sand to work into loam at the surface; and the beds of laminated clay belonging to the stratified part of the drift make the heavier land. The difficulty of indicating the kind of soil under these conditions by the conventional methods of drift-mapping has been discussed in Chapter XI. (p. 430), where information will be found as to the localities where the map might seem misleading. The practice of 'marling' the lighter tracts was at one time universal in this area, but is now practically abandoned except on the blown-sands along the southern edge of The Ayre. As already described, the 'marl' usually consisted of boulder-clay or stratified glacial clay (p. 418), but occasionally of late-glacial or post-glacial fresh-water deposits (pp. 378-81); both contain some lime (pp. 464-5), but, as Cumming remarked, the benefit to the land was probably more on account of improved texture and general renovation than from this ingredient alone.¹ Berger mentions that "150 tons of marl are computed to be necessary for an acre of land," but this was probably an extreme quantity; he adds that the cost of the operation was £6 per acre if the cartage did not exceed a mile, and that "the cost of liming, a practice chiefly used in the southern part of the isle, is nearly the same," 90 bushels of lime to the acre being allowed.² Seaweed is still extensively used for manure in parts adjacent to the coast, and in this way, as well as by 'marling,' many pebbles etc. have been artificially introduced into the soil,—a fact to be borne in mind by the glacial geologist.

Next in importance to the northern plain as an agricultural tract is the southern lowland, overlying the Carboniferous rocks

¹ "Isle of Man," p. 306.

² Trans. Geol. Soc., vol. ii., p. 55.

and extending beyond them up the gentle slopes of slate to 600 feet or more above sea-level. The lower ground in this tract closely resembles that of the northern plain, excepting that sand- and-gravel soils are less prevalent and tend to be more loamy, and the boulder-clay soils are darker, tougher and more calcareous. On the upland slopes the drift is mainly derived from the local slates and, though mapped as 'boulder-clay,' gives rise to soil which is not, as a rule, stiff, but usually a deep stony loam full of subangular fragments of slate, with patches of thinner rubbly soil where bosses of the solid rock approach the surface. This kind of land is predominant all over the hilly tracts wherever agriculture is attempted. Where the soil consists entirely of loose slaty *débris*, derived either from the subjacent decomposed rock-surface or from slaty drift of the gravelly type, it is termed by the Manx farmers "shilly" land; this produces better crops than its extremely stony appearance would lead one to expect, especially of oats, turnips, and potatoes; but it loses moisture rapidly, and suffers in a dry season. The patches of cold wet clay-land, difficult to drain and difficult to cultivate, occurring on flats and depressions both on the uplands and at the foot of the hills,—the result of the rain-wash and weathering of the drift—have been described in a previous chapter (p. 453); such 'Colby wash' soil has usually a dark grey colour instead of the rusty brown of the mellower slaty land, and is generally full of bits of vein-quartz which have remained unaltered while the slate fragments have decomposed into mud.

On the eastern flank of the Island there is more or less cultivation on the hill-slopes from end to end, but on the western side the cultivated strip extends only as far south as Dalby. In the interior, south of the central valley the greater part of the drift-covered area is or has been tilled, but among the hills north of that valley a much smaller proportion is cultivated, and the area devoted to upland sheep-walks is constantly increasing at the expense of tillage. Macculloch as long ago as 1819 pointed out that the cultivation of elevated ground had in some places extended "further than prudence would have dictated or profit will ultimately justify";¹ and his dictum has been fully borne out, the uplands being everywhere dotted with the ruins of deserted cottages and small farmsteads; the little fields surrounding them, once under the plough, now producing only rough pasturage. This diminution in the proportion of arable land, as marked in the Island as in Great Britain and Ireland, is illustrated in the following statistics.² These figures also show to what an insignificant percentage the growth of wheat has shrunk, the grain

¹ "Western Isles," vol. ii., p. 519.

² From the annual Parliamentary Blue books: "Agricultural Returns." In the Return for 1899, the quantity of "Mountain and Heath land used for grazing" (not included in the Table) is given as 23,110 acres, and "Woods and Plantations" as 826 acres.

crops now consisting almost entirely of oats and barley, with turnips and potatoes as the principal root crops.¹

Year.	Total area of Land and Water.	Wheat.	Barley.	Oats.	Green Crops.	Clover and Grasses under rotation.	Permanent Pasture.
	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
1866	145,325	8,073	7,736	11,010	12,708	25,309	9,762
1876	"	6,181	7,210	12,324	12,045	34,373	20,517
1886	"	1,128	9,256	13,485	11,859	42,026	19,948
1896	145,011	809	7,452	13,789	11,263	38,009	22,904
1899	"	1,018	7,258	13,268	10,993	38,670	20,141

Water Supply.

The water supply of the Island is practically all obtained from the surface-streams or from shallow wells, there being no available deep source. The slate-rocks are waterless, except for a slight percolation along the lodes (see description of mines, pp. 532-3, etc.) and along joints near the surface in the quartz-veined grits; consequently there are scarcely any true rock-springs, though water oozes out abundantly from the base of the rubbly local drift and shaken rock on the hill-slopes and in the valleys. The Carboniferous Limestone of the south is too thinly bedded and intercalated with shale to afford a good supply, and few wells have been sunk in it (pp. 207, 471); some deep quarries in this rock W. of Ballasalla are unwatered by wind and steam power, the discharge being of good quality, and estimated to average about twenty-six million gallons per annum²

All the towns possess organised water-systems supplied from reservoirs near the heads of the streams, Douglas thus utilising the Glass and the Groudle Rivers; Castletown, the Silverburn; Port St. Mary and Port Erin, the Colby River and a stream E. of Fleshwick; Peel, a stream from the Slieau Whuallian ridge and from

¹ Berger quotes (op. cit., p. 32) the following figures from J. C. Curwen's "Report of the Agricultural Society in the Isle of Man" (Workington, 1810):—

"Acres.
100,400 of mountain.
69,045 for grazing.
30,158 in oats.
15,079 under barley.
14,761 under green crops, 710 of which may be
considered as potatoes.
9,047 in wheat.
7,270 in roads, rivers, houses.

Total 245,760 acres."

But as this total greatly exceeds the actual acreage of the Island, the table is not of much use for comparison.

² We are indebted to T. Moore, Esq., for this information.

Glen Rushen; and Ramsey, the head of Ballure Glen. The country districts depend either upon the streams or upon small shallow wells, often very inadequately protected from contamination; the latter, on the low ground, are generally in water-logged beds of drift not far below the surface; and in the hilly districts are usually little basins excavated in the slate in a position to catch the percolation between the solid rock and the overlying rubble or drift. The conditions of supply on The Ayre and other parts of the northern plain have previously been discussed (pp. 285 & 417), and particulars of a few wells in other districts are given in Chap. XI.

APPENDIX I.

LIST OF MINERALS KNOWN TO OCCUR IN THE ISLE OF MAN.

(The Lode-Minerals are mainly on the authority of Sir W. W. Smyth's List, in Trans. Isle of Man Nat. Hist. and Antiq. Soc., vol. i., pp. 143-147.)

Name.	Localities and Remarks.	
	Lode-minerals.	Rock-forming minerals.
Actinolite	—	As alteration-product in dyke-rocks (p. 308).
Albite	—	In some igneous rocks.
Analcime	—	As decomposition-product in basalts.
Anglesite	Glenschass Mine (s) ¹	—
Anthracite	Laxey Mine (see p. 520)-	—
Antimonite	Niarbyl Mine, (p. 546) -	—
Apatite	In a vein near Foxdale Granite (Kendall)	In small crystals in many igneous rocks.
Atacamite	North Bradda, old workings (s)	—
Augite	—	Common in intrusive rocks.
Barytes	Foxdale; rare at Laxey (s); North Laxey	—
Biotite	—	Common in igneous rocks, and detrital in slates.
Calamine	Laxey (rare) (s)	—
Calcite	Common in lodes	Chief constituent of limestones, and alteration-product in basic igneous rocks, etc.
Cerussite	Glenschass, Rushen, and Bradda Mines (s).	—
Chalcanthite	Old workings, Laxey, Bradda (s)	—
Chalcedony	Cornelly Mine: as <i>Agate</i> in Bulwark Lode, North Bradda (s)	As pebbles, in Peel Sandstone and in Glacial deposits.
Chalco-pyrites	Laxey: Foxdale (rare); Maughhold Head; Langness (s), and other places	—
Chalybite (Siderite)	Foxdale, Cornelly, and other mines	As decomposition-product in some igneous rocks.
Chlorite	Bradda and Rushen Mines (s), and common in quartz veins	Common as alteration-product.
Chloritoid (Ottrelite)	—	In altered elvan on Greeba Mountain (p. 318) and probably in other altered rocks.
Cuprite	Bradda Mine (s)	—
Diagite	Snaefell Mine (s)	—
Dolomite	Common in lodes	In Carboniferous Limestone and sparingly in decomposed basic rocks.

¹ Localities marked (s) are from Sir W. W. Smyth's list.

Name.	Localities and Remarks.	
	Lode-minerals.	Rock-forming minerals.
Epidote	—	Common as alteration-product especially in basic dykes
Fahlerz (see Tetra- hedrite)		
Felspar (see Orthoclase, Plagioclase, etc.)		
Fluor-spar	Old Foxdale (s) - -	—
Galena	In many lodes : more or less argentiferous	—
Garnet	—	As alteration product ; and detrital in grits.
Gold ?	see p. 549 - - -	—
Graphite	Snaefell Lode (impure) (s). Beary (p. 550).	Graphitic slate in several local- ities : see p. 134.
Gypsum	Many veins in Triassic and Carboniferous rocks in deep borings on The Ayre.	—
Hematite	Maughold Mines - - -	—
Hornblende	Cornelly lode (s) - -	Common in intrusive rocks (see p. 301).
Ilmenite	—	Common in many rocks.
Iron-pyrites	Common in lodes	Common in many rocks.
Kupfer- nickel	Glenchass (s) - -	—
Labradorite	—	In basic igneous rocks.
Leucoxene	—	As decomposition-product in igneous and metamorphic rocks.
Limonite	Maughold Mines (s)	—
Magnetite	—	Common in igneous rocks.
Malachite	Bradda Lode (s) -	—
Malacolite	—	Variety of augite common in basic dykes (p. 301).
Manganese- spar (see Dialogite)		
Marcasite	Laxey, Bradda (s), etc.	—
Melaconite	Laxey and Bradda Mines (s) -	—
Melanterite	Old workings, Laxey, etc. (s) -	—
Mica (see Muscovite, Biotite, etc.)		
Microcline	—	In Dhoon Granite elvans and in granite at Cornelly Mine.
Millerite	Trial-shaft at Rhenas (s) -	—
Molybdenite	On joints in Dhoon Granite -	—
Muscovite	In many quartz veins (p. 320)	Common rock-constituent.
Nickel-ores (see Kup- fernickel and Mill- erite)		
Ochre	Rushen and Bradda (s) - -	—

Name.	Localities and Remarks.	
	Lode-minerals.	Rock-forming minerals.
Oligoclase	—	Common in some igneous rocks.
Olivine	—	In basaltic dykes.
Opal	Var. semi-opal; Cornelly Mine (s)	—
Orthoclase	—	Common in igneous rocks.
Picotite	—	In Carboniferous diabase (Hobson).
Plumbago (see Graphite)		
Plumosite	Foxdale Mine (p. 503)	—
Pyrites (see Iron-pyrites and Chalcopyrites)		
Pyrolusite	Upper part of several lead-veins (s)	—
Pyromorphite	Rushen and Laxey Mines (s)	—
Pyrrhotite (Pyrrhotine)	Snaefell; Laxey (rare) (s)	—
Quartz	Chief constituent of veins in slates	Common rock-constituent.
Riebeckite	—	In Ailsa-Craig boulders in the drift.
Rutile	—	Common in altered slates and in some igneous rocks.
Sericite	—	Common as alteration-product in sheared rocks.
Serpentine	—	As decomposition product after Olivine.
Silver-ore (see Fahlerz and Plumosite)		
Sphale	—	As alteration-product in igneous and metamorphic rocks.
Staurolite	—	As alteration-product at margin of Dhoon granite; rare. (G. Barrow.)
Steatite	Foxdale and Laxey Mines (s)	—
Stibnite (see Antimonite)		
Tetrahedrite	Foxdale Mines (s)	—
Tourmaline	In quartz-veins near granite (see p. 143).	Common as alteration-product in igneous and metamorphic rocks, etc.
Tremolite	—	Alteration-product in some dykes.
Uralite	—	Variety of hornblende, common in basic dykes (see p. 301).
Zinc-blende (Sphalerite)	In many lodes	
Zircon	—	Small grains in grits; also in igneous rocks.
Zoisite	—	As alteration-product in igneous rocks.

APPENDIX II.

SOME PUBLISHED ANALYSES OF MANX ROCKS.

Analyses from Dickson and Holland's paper :—on "An Examination of some Volcanic Rocks of the Isle of Man," in Proc. Liverpool Geol. Soc., vol. vi. (1889), pp. 126-129.

Specimen showing junction of microgranite dyke at Crosby with the slates.

"Analysis of Elvanite portion of specimen."

"Sp. Grav. 2.72.¹

SiO ₂	-	74.39
Al ₂ O ₃	-	15.55
Fe ₂ O ₃	-	1.35
MnO	-	0.22
CaO	-	0.48
MgO	-	0.33
K ₂ O	-	2.14
Na ₂ O	-	3.79
Combined water	-	1.18
		<hr/> 99.43

"Analysis of the slaty portion of the rock at the point of junction

SiO ₂	-	49.03
Al ₂ O ₃	-	24.83
Fe ₂ O ₃	-	3.68
FeO	-	5.57
MnO	-	0.26
TiO ₂	-	1.09
CaO	-	1.80
MgO	-	2.68
K ₂ O	-	5.09
Na ₂ O	-	2.96
Combined water	-	2.57
		<hr/> 99.56

"Not enough of the specimen remained to enable a satisfactory estimation of the carbonaceous matter to be made. P₂O₅ was detected in this specimen, but was not estimated, as also S.

"Thinking it would be interesting to have a specimen of the unaltered slate rock examined chemically so as to compare it with the rock near the point of junction, a specimen was kindly sent by Dr. Tellet of Ramsey, from Sulby, a place about 5 miles from Crosby."

¹ Mr. Hobson states that the sp. grav. of this rock is 2.62 (Quart. Journ. Geol. Soc., vol. xlvii., p. 439).

"Analysis of unaltered Silurian from near Sulby.

"Sp. Grav. 2.79.

SiO ₂	-	-	-	57.25
Al ₂ O ₃	-	-	-	21.51
Fe ₂ O ₃	-	-	-	1.30
FeO	-	-	-	5.71
MnO	-	-	-	0.48
TiO ₂	-	-	-	0.94
CaO	-	-	-	0.61
MgO	-	-	-	1.92
P ₂ O ₅	-	-	-	0.13
S	-	-	-	0.22
K ₂ O	-	-	-	3.75
Na ₂ O	-	-	-	1.82
Combined water	-	-	-	4.32

99.46

"Carbonaceous matter approximately 0.5 per cent.

"It seems remarkable that there should be 8 per cent. more silica in the unaltered than in the altered rock."¹

"Specimen ['altered basalt'] from summit of Scarlet Stack.

"Sp. Grav. 2.62²

SiO ₂	-	-	-	-	46.70
Al ₂ O ₃	-	-	-	-	13.74
Fe ₂ O ₃	-	-	-	-	5.43
FeO	-	-	-	-	9.88
MnO	-	-	-	-	a trace
TiO ₂	-	-	-	-	1.94
CaO	-	-	-	-	3.95
MgO	-	-	-	-	6.24
K ₂ O	-	-	-	-	1.36
Na ₂ O	-	-	-	-	3.48
CO ₂	-	-	-	-	1.68
Combined water	-	-	-	-	5.88

100.26

"Specimen of gabbro from the most westerly quarry at Rockmount.

"Sp. Grav. 2.26³

SiO ₂	-	-	-	-	47.13
Al ₂ O ₃	-	-	-	-	8.48
Fe ₂ O ₃	-	-	-	-	6.15
FeO	-	-	-	-	5.54
MnO	-	-	-	-	0.64
TiO ₂	-	-	-	-	0.58
CaO	-	-	-	-	11.34
MgO	-	-	-	-	13.61
K ₂ O	-	-	-	-	0.22
Na ₂ O	-	-	-	-	1.28
CO ₂	-	-	-	-	0.47
P ₂ O ₅	-	-	-	-	0.32
Combined water	-	-	-	-	3.90

99.66

¹ As the specimens were from widely separated localities, the disparity commented on may only indicate that the Sulby rock was originally more sandy than the other. [G. W. L.]

² Mr. B. Hobson re-determined the sp. grav. and found it to be 2.76. (Quart. Journ. Geol. Soc., vol. xlvii, p. 441.)

³ Sp. grav. corrected by Mr. B. Hobson to 2.76.

"Carboniferous shale from a deep boring [Knock-e-Dooney] in the Isle of Man," by W. Maynard Hutchings (in "Clays, Shales and Slates"; Geol. Mag., July, 1896, dec. iv., vol. iii., p. 309).¹

Silica	58.75
Alumina	19.15
Ferric Oxide	3.90
Lime -	1.15
Magnesia	1.95
Potash	3.48
Soda	1.54
Carbon dioxide -	1.36
Water and organic matter	8.87
	<hr/>
	100.15

¹ The specimen analysed by Mr. Hutchings was from a depth of 805 feet in the above boring.

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